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LAND, SEA, AIR OR SPACE... TALENT THAT BUILDS BETTER DEFENSE SYSTEMS

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Expanding the Airline Market

(By Paul W. Champagne, Harvard Business School professor and author of the Champagne report on airline air transportation, discussed in the editorial market in a recent issue of *General*.) *Editorial Note:* Because of its proximity to recent airline problems, significant content from this feature is omitted.

A variety of airline commentators have developed a new "conventional wisdom" in the airline industry. It is claimed that the failure of traffic growth to keep up with capacity is essentially a failure of marketing. This general line of argument takes a variety of forms. Some claim that all that is needed is a loosening of fares, since that market research will already have shown that bigger and better advertising and promotion is the solution. Those who hold this view might be described as "marketing optimists."

These marketing "optimists" are countered by what might be described as the economic "pessimists" who claim that the airline industry has now reached a state of maturity where about all that it can expect is to grow at a rate about equal to that of the economy (3%). The "pessimists" consider that a good product and good work might achieve a 3% rate.

A favorite charge of the marketing "activists" is that only about 75% of U.S. citizens travel by airline in any one year and that only about 25% have ever flown by airline. These figures are usually cited to show that as travel is not keeping up to its market potential in the air market.

The basic reason for this high concentration of air travel is the fact that a high proportion of air travel (at least two-thirds) is for business reasons and is composed of executives, professionals and technical personnel who are required to travel frequently in connection with their business. Their travel is done on an expense account at or least is tax deductible. This means that frequency of travel and destination are dictated by business or economic factors. There is some reason to suppose, first, that this segment of the airline market is approaching saturation, and second, that it is increasingly resistant to general product changes.

One phenomenon of the last few years has been the growth of many business travelers out of first class into coach or tourist accommodations at the behest of their employers (government, industry or themselves). This switch, while not surprising, reflects the wide differential between first and coach class tickets (about 250%) and the fact that on long trips a price differential of 54% buys only the following:

- A seat that is three inches wider.
 - Five extra inches of legroom.
 - Four ounces of free liquor, estimated maximum retail value \$12.00.
 - A meal that costs about \$12.25 more than that served in coach.
 - Less risk of being exposed to transient children.
 - Less risk of having to sit in the "middle" seat.
- The federal government, many corporations and numerous individuals have concluded that the list of goods is overpriced. Some action has been attempted, so far unsuccessfully, to narrow the gap by raising coach fares.

The generation of additional trips by existing business air travelers appears to be largely a matter of product and service. Increased speed, reliability, and convenience of travel can be expected to result in a few more trips that would otherwise not be made, the business air traveler being handled by letters, phone or telex per trip. If it should nevertheless, however, be shown that these service improvements might yield in the way of increased traffic. When entering transportation markets was considered, the true cost/aircraft market line (aircraft themselves appear to have grown about 2% faster than might otherwise have been

expected). The inelasticity of jets appears to have added another 2.5% to the expected market. In the short haul markets, the air traveler's share of the total cost appears to have increased total business travel at about 5.33%. There is little indication that price, at least in the near term of 1979, will appreciably affect total market expansion although it may cause shifts between classes of service.

The part of the airline market that is not traveling for business is the same for a number of passengers—vacation, visits to family, personal emergencies and the like. Whereas business travelers average about seven air round trips a year, non-business travelers average two, and while in a group non-business travelers are more numerous, they account for considerably less total demand on travel than business travelers.

The economics of a long-distance trip by common carrier pose a basic market dilemma here. Consider a family with two children in Chicago who want to spend 10 days in Arizona. What is the maximum that they can expect to spend? Assuming that they have their children behind with friends and relatives at so not their vacation expenses are in the vicinity of \$700 including plane fare (\$480), hotel (\$120), and other expenses at destination (\$100). If they take their children and mother \$100-\$600. This is the equivalent of a year's depreciation on their new car (less a rebate for the car when sold) and is more than their house paid for down, even at medium-priced homes, all established and accepted expenditures in one outlay. And what is the attraction of Arizona? The answer is none, if not hot, and certainly inferior to Chicago. There is scarcely any which a motel on is needed and there is a suggestion in the advertisements of beautiful golf at scenic bathing spots, making the wife nervous and leaving the husband torn between deer and golf. Such purchasing the only TV in color and radio and next summer the whole family can drive to some nice lake 100 miles into Wisconsin.

If the foregoing is in any way a brief portrait of a real (vacation travel) situation, consider an implication. In the airlines. They can cut their fares in half and still only reduce the total price to \$350. They can provide better service between Chicago and Phoenix in the fastest air route but that still will mean nothing to the family if it has decided not to go to Phoenix.

It is often objected that there are not enough people with enough money to travel for pleasure, even if there were enough attractive destinations. The facts indicate otherwise. In 1978, there were 13.5 million families and approximately 25 million individuals (about 25% of the total who had above-average personal income) with an income of \$12,000. If we deduct \$5,000 in minimum living expenses for food, shelter and clothing, and then reduce the remaining balance by 50% for other fixed obligations, we find that these 13.5 million families have a total of \$44 billion of "discretionary" funds. If 10% of these families were to take a two-person trip to an extra trip of 1,000 mi. (one-way) it would amount to the present ability of the airlines to handle the business, or, at least, it would. \$4 billion passenger miles is an 18% increase in total air travel.

Yet the air fare picture of these trips would show about less than 2% of these discretionary funds. Penetration of 10% of these open-income families would be a modest enough figure but exceeds the competition for these discretionary funds. . . . hotels, cars, gardens, eating, sports, etc., etc. It will be hard to capture these 11 million families for air transportation. But to say that the market does not exist is to ignore the facts.

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Washington Roundup

MMRBM Contracting

An Air Force recommendation on Phase I contractors for the mobile intermediate ballistic missile (MMRBM) was scheduled to go to Defense Department last last week for approval. At one time the plan was to have two or more competing contractors for early selection during the initial program definition phase, but the Air Force was expected to propose only one, the most competitive. An exception is the cruise vehicle, where both Avco and General Electric were strong candidates. Leading contenders in other areas were believed to be Martin-Bellanca for command and control, Nucleon for integration and checkout, AMP for transport-control-launcher, and Thales for propulsion. A decision on guidance contractors already is overdue (AW June 25, p. 29).

Need for a counter-missile close-support aircraft (CSA) for use in areas such as Vietnam (AW May 26, p. 45) has pulled into a specific operational requirement that is being considered in industry prior to a request for proposals. It calls for a 17,000-lb. aircraft with short takeoff and landing capabilities and tailhook engagement. One engine manufacturer states that a 1 to 1 thrust in weight ratio could be obtained by creating a 13,000-lb thrust engine and giving the rest of the thrust from the propeller.

Titan 3 Go-Ahead Near

Document officially approving the release of funds for the beginning of Titan 3 development, effective Aug. 1, was signed by Assistant Secretary Robert M. Smith's desk sometime last September. One major consideration that has helped delay approval is the proposed Space Technology Laboratories Area guidance system. The statement is being made that the AC Space Flight Program guidance system used on the Titan 2 would be satisfactory and its use would save the cost of developing a new system. Release of funds for Titan 3 might result in a definitive contract by Aug. 15 for United Technologies Corp.'s development of the 130-in. dia. solid propellant booster. Work is now being done under a 45-day fixed-price contract which covers program planning, including resolution of interface problems with Martin, the integration contractor for the vehicle.

Newest presidential aircraft, a Boeing VC-137C, was rolled out at the company's Renton, Wash., plant on July 20. The specially-drafted version of the 747-120C, largest of the Boeing jet transports, is painted light blue and white with a gold trim. The aircraft will supplement the fleet VC-137A, which are modifications of the 747-120, now used in the White House. Because of the special communications equipment, cost of the new aircraft is difficult to estimate. The Air Force's budget requests that year included \$5 million for a new presidential plane. A commercial 747-120C sells for \$718,000 with the needed airline interior and main engine, which cost \$264,995 each.

Army Caribou Flap

Army is in hot water with the director of defense research and engineering for announcing that GE Hamilton had won the STOL transport competition (AW July 21, p. 28) without consulting the research office or even asking for release of the development funds. The research office feels there is insufficient consultation between Army's top research and development officials and the transportation group development group at Ft. Belvoir, and that the evaluation done at Ft. Belvoir for the STOL competition was unprofessional. Army still had not specified the engine for the winning Caribou 2 but, last week, although there was little doubt that GE Hamilton's preference—the General Electric T64—would be chosen.

Three space committee hearings on solid propellant, scheduled for Aug. 1 and 2 (AW July 25, p. 17), have been postponed until Aug. 8-9.

Earth Orbit Rendezvous

Watch for National Aeronautics and Space Administration to expand the near-orbital aspects of the Gemini spacecraft program to take up some of the slack created when the decision was made to use lunar orbit rendezvous for the Apollo program instead of earth orbit rendezvous. NASA is fully aware that it is neglecting investigation of earth orbit rendezvous. Air Force will ask for the reason.

Pentagon may take consultation from the fact that the troubles of officials aren't limited to one statement. After the recent shakedown of the Berlin crisis, new Minister of Armaments, Defense, and General Staff, Gerhard Schröder, has been named. Last Friday morning, 1961, "Concerning with some of the 10 months, the disposal of defense of our state. In a moment of experience I allowed myself to say 'I am more member of state, what I would do it this.' Hardly was the words out of my mouth when the skies darkened and the ground began to tremble and we embarked on the convulsions of the world." When the dust settled I found that I was witness of a new era of the world's great changes, with their small thought, had changed matters so that I had an opportunity to express my view on aviation policy within less than 24 hr after entering my own office."

—Washington Staff



Dassault Balzac VTOL, based, scheduled to begin initial flight tests this week, is a converted Mirage 3C jet fighter.

Dassault Rolls Out Balzac, Speeds Tests

By Cecil Browson

Paris—France's Dassault Balzac VTOL jetbed a converted Mirage 3C fighter with a total of eight Rolls-Royce RB168 lift-thrust engines outboard in the fuselage, is scheduled to begin scheduled flight tests sometime this week.

The massive Balzac was rolled out last week as forerunner of the larger Mirage IV. Mach 2 plus interceptors. Turbofans are being pushed through an air test house by Dassault in an effort to achieve positive results before Aug. 7.

That is the deadline date for the ad hoc advisory committee within North Atlantic Treaty Organization to make its final recommendations to the organization's permanent committee for a standard NATO VTOL strike fighter under terms of the present treaty, longer NATO-BMR 3 competition [AWM Jan. 14, p. 20].

A total of 12 criteria originally were submitted, and informed elements have now before the committee recommendations will call for production of two prototypes each of the Mirage IV and the Balzac's competing Hawker P.1154 to evaluate both design concepts. As opposed to the lift-thrust plus external pod concept principle of the Mirage IV, the P.1154 design includes a 27,000-lb. version of the variable-thrust Bristol Siddeley BS55 powerplant which can be used in both vertical and horizontal flight regimes.

Tonnage tribute of the P.1154, the Hawker 1127, stretched in flight but the sleek shape of the latter, especially around the Mirage IV, may be lost by 1966, a full two years, it says, before the P.1154 can be available in quantity.

The company also claims the first prototype of the IV will be rolled out by next July and three months later, after extensive ground tests.

Further down to the Mirage IV program within and outside NATO is cover from the French government decision to fund production of the first two prototypes. This is the evaluation quantity estimated by NATO.

France has not declared that the IV is a national defense project and it is successful will be ordered into quantity production whether or not it is NATO's final choice for a standard northwestern strike fighter.

British's Decision

British apparently has made a unilateral decision regarding the P.1154. A national commission within the United Kingdom for a VTOL strike fighter, set up in 1961, is in the process of recommending a standard NATO VTOL strike fighter under terms of the present treaty, longer NATO-BMR 3 competition [AWM Jan. 14, p. 20].

A total of 12 criteria originally were submitted, and informed elements have now before the committee recommendations will call for production of two prototypes each of the Mirage IV and the Balzac's competing Hawker P.1154 to evaluate both design concepts.

A third design under serious consideration is the ad hoc committee, the variable-thrust, Mach 2.5 Republic F-105, which is a variable-thrust jet engine. It is a BMR 3 competitor but with a variable-thrust jet engine. It is a BMR 3 competitor but with a variable-thrust jet engine.

In view of the British and French stand, support of one level or the other was considered necessary before the Ad Hoc could be proposed to NATO's permanent committee for the ad hoc selection group. The latter committee began its final discussions on BMR-1 last week.

Although not a JV, indicated flight by the Balzac before the Aug. 7 deadline is considered a "must" by Dassault.

Although the firm closed down after the initial test work for its own facilities for those all engines, permanent directly connected with the Balzac project were told so soon as the first Mirage IV strike fighter was flown at the first flight of the aircraft has been achieved.

The major purpose of the Balzac will be to test bleed-off, pitch and yaw stabilization systems planned for the IV under the most full and range of the aircraft during normal flight regimes in the VTOL regime. The Balzac system already has undergone extensive wind tunnel testing and, if successful in actual flight, will be adapted without change in the Mirage IV.

Another two positioned under the rear of each wing just outside the outboard fuel loading gear are for roll correction. A third set, with one engine on either side of the rear of the fuselage, controls yaw.

As for the stabilization system, a third set of eight RB168s, which have thrusts of 1,900 lb. each, and it is intended to a common ducting system for all engines. The ducting system has three valves, one each for pitch, roll and yaw control.

The system can be manually operated by the pilot through two selection panels although pitch and roll are automatically controlled and compensated for by the Dassault design computer connected to the vertical control column within the cockpit.

Within the tailpod cockpit, the pilot has three control levers for selecting the vertical lift powerplants, each selecting engine power, one engine of each pair on either side of the fuselage for balance. In addition, there is a

lift throttle, which also has thrust grip to regulate thrust of the horizontal engine during transitional phases.

Dassault officials say the lift-thrust engine principle as such, already has been proved by performance of the Short SC1 in Great Britain and that testing of the stabilization system is currently the only step needed before proceeding to use with the Mirage IV. The IV will inherently resemble the present testbed although, to gain space for additional fuel, its fuselage will be stretched, and maximum gross weight will grow from under 20,000 lb. to 28,000 lb.

Paul, currently 172 imp. gal. in the Mirage 3C, has been increased to 400 gal. in the testbed to permit stabilization of the lift thrust engines. Major task is in the middle of the fuselage at the center of gravity. Four auxiliary tanks are split one in each wing and two others in the fuselage.

Dassault engineers estimate fuel should still provide 12 min. of level flight, during low transitional phases, 15 min. in the air, allowing 20-40 sec. for each VTOL and landing phase.

Inter-system for the horizontal position, system as built for the Balzac and the Mirage IV is directed to an S-shaped swing into the fuselage to permit positioning of the lift engines just aft of the others in the intake ducting.

For the lift engines, a large ducted door runs vertically in front approximately 15 in. and leaves on top of the door are opened for the initial takeoff phase. Lower one-lens door for the RB168 lift engines swing to either side, at speed raising the upper, loaded levers are closed and, after transition is completed, the door still is closed to a final position.

Powerplant installation is essentially the same for the Mirage IV and the Balzac, four engines mounted at the intake. As in the Balzac, two lift engines will be installed in the IV in parallel slightly aft of the cockpit and another two in the same configuration is behind.

The other four will be arranged in identical fashion in the other fuselage inlet faning.

Dassault now is divided to go ahead with the Balzac testbed rather than a JV prototype primarily, because the -closed lift engines for the JV—Rolls-Royce RB168s will not be available before 1965. Dassault wanted to test the overall principle at the earliest possible date. The RB168, which has a thrust-to-weight ratio of 10:1, will deliver about 4,000 lb. thrust in powerplant in test stand push-in initial TV configuration. Growth, however, will be to the 5,000 lb. thrust.

Development of the RB168, which has been running in a test stand since last November, is being financed by



Model of the Dassault Balzac VTOL, prototype engine, had thrust tested at Rolls-Royce aircraft and development test facility at Warton. Engines are four pairs of RB168. Dassault Mirage IV follow-on will be powered by eight RB168s.

Britain, France and Germany. Rolls for the past year has been working toward the engine's performance in model configurations of the IV program to evaluate basic intake design for lift-thrust engines.

Elemental powerplant for the IV will be the Senelec TP106 of 10,645 lb. thrust with afterburner in opposed to 11,325 lb. thrust of the Senelec A4 powerplant the Mirage 3C. Rev. 101 Siddeley Deyton 3 in the Balzac, built without afterburner, is rated at approximately 5,000 lb. thrust. The TP106 is a growth version of the Pratt & Whitney JT10 turbofan.

Many IV will use the same type vertical fan as that of the Mirage 3 and the Balzac. Although somewhat larger, the delta planform of the Mirage 3C will be retained in the IV.

Finally, also will follow general layout of the Mirage 3 [AWM July 24, p. 18], although the new role configuration has disappeared in the Balzac as roles have been willing to accept the lift engines and will be strong in IV for the same reason. Dassault says that, with increased thrust, change in two-stage configuration will have no effect on IV performance which is to match that of the SC.

Fuselage of the IV will be semi-fuselage under partnership agreement by Sud Aviation British Aircraft Corp. and Boeing Co. also have American production rights should the aircraft be ordered in either Britain or the U.S. Chances now appear slim in Britain, but Boeing may be launched that its IV or a derivative may be accepted in the U.S.



Egyptian military soldiers were deployed last week in a parade marking the 30th anniversary of the overthrow of King Farouk. United Arab Republic announced it had successfully shot several of the missiles. Missile on track appears to follow design of World War I German V-2, with some resemblance in later model Roman T-2 medium range ballistic missile. Combat forces are positioned in the north flow in V-2 launch and missile has either a short range T-2 launch design, or a prototype carrying one solid rocket.



Defense Fights Move to Broaden GAO Role in Negotiated Contracts

By Katherine Johnson

Washington—Defense Department has launched a major offensive against legislation extending General Accounting Office's authority to veto its negotiated contracts.

Approval by the secretary of defense, or a service secretary, is now final on all negotiated contracts unless the director is a clerk flag. GAO has an authority to withhold money payments on all federal government contract.

The legislation that has caused the Defense Department to launch a campaign against negotiated-type contracts to possible modification by GAO, according to Thomas D. Morris, assistant secretary of defense, has been passed by the House—passed by Rep. Carl Albert (D-La.) and supported by GAO—was passed by the House, 361 to 8, and is now pending before Senate Armed Services Committee (AW Item 18, p. 28). It would also require contractors to submit their cost data to "current accounts, and compliance."

Spouses of the legislation place a far more important role than does the Defense Department. Vinton told Senate Armed Services that it would give this authority to GAO "in only the very rare case."

Procurement Law
The defense procurement law requires federal advertised bid contracts, but as through 17 justifications for negotiated contracts. Approval by the secretary of defense of any contract negotiated under any 17 of these justifications is now final.

Under the Vietnam War proposal, the contract determination of the secretary of defense under 6 of the 17 justifications would be final "unless there is clearly evidence of a not properly or substantial evidence."
This provision would apply to these classes of negotiated contracts:
• Research and development work.
• Contracts which "should not be publicly disclosed."
• Contracts negotiated to award (1) construction and (2) acquisition of equipment.
• Contracts negotiated because they involve a substantial initial investment or an extended period of preparation for manufacture.
• Contracts negotiated after collusion among bidders was indicated under

formal advertised bidding procedures.

• Contracts negotiated in the interest of maintaining an industrial establishment base for an enterprise.

Money provided by the committee that under the Vietnam War proposal, General Accounting Office would have with Defense Department as to whether contracts negotiated under these classes criteria were justified with the intent to withhold. Defense Department decision to withhold payments. It said it would be a case of "shaky authority without sound responsibility" for national defense.

"Contractors could argue that contracts made in good faith with the government, would not be voided on the basis of discrepancies within the government's accounting of public, army, with contract have been. Money told the Senate committee.

"Government would similarly be faced with the prospect of serious program changes because of non-compliance, action to require, would not be considered."
Morris and the previous would authorize GAO to pass on such contracts payment contractors as when a contract is in the area of research and development, when a contract should be classified, whether there should be standardization of equipment, in the acceptance to the membership base of a particular plant or manufacturer.

According to John Corcoran, director of the House Armed Services Committee and sponsor to Vinton, dissent on the legislation the provision does not more than allow GAO to veto a contract which was awarded on the basis of other available information in the contract and pricing and would do nothing whatever to bring GAO into the area of contract decisions.

Veto Previews
In his appearance before the Senate Armed Services Committee, Vinton announced the significance of the GAO veto power and described his testimony to a strong plea for enactment of the proposed sweeping collection of contracts to incentive type contractors.
Although Defense Department has issued a procurement regulation requiring that contracts include conditions of cost data by the contractor, Vinton said it is not being applied. He reported that a study of the 188 contracts awarded since the regulation was issued a year and a half ago shows that 121 of the contracts included no cost data certification.

Morris later warned the committee that this situation is being corrected.

He opposed the authority previously advocated by Vinton that an incentive-type contractor certify his cost data in current, accurate, and complete. Morris suggested language similar to the Defense regulation that a contractor certify that "to the best of his knowledge and belief all actual or estimated costs of passing data... have been cost." Vinton, however, knew to the contracting officer for his use in evaluating the estimate.

The last order of business Vinton stressed, it is to end over-allowing and under-allowing of contract costs. "Let us close the door on this issue and for all," he urged with a law providing for "truth in negotiating."

Venus Mission Fails; New Mariner Readied

Cape Canaveral—Several attempts to send a Mariner spacecraft on a Venus mission, including the National Aeronautics and Space Administration's second attempt, at the earliest, after an unsuccessful attempt to launch an identical probe last July 12 (AW Item 25, p. 16).

The Mariner 10 launch vehicle was fired at 4:28 a.m. EDT from Pad 12 in what appeared to be a normal launch. But approximately 38 min. later it began to deviate in pitch and yaw from the intended trajectory. Approximately 290 sec. after lift-off, and roughly 10 sec. before scheduled cutoff of the Atlas boosters, the Air Force Marine Test Center range safety officer declared the vehicle destroyed.

A detailed analysis of telemetry was under way to determine the true cause of the trajectory deviation.

The fact that the source deviated from desired trajectory, probably was a result of some malfunction, rather than a simple random disturbance, suggested to some observers that the fault might have been in the flight path equation used in the General Electric five-stage command guidance system computer.

Air Force Atlas Agena and Mariner systems, which have been at the Cape for a month, were immediately readied for another on Pad 12.

The original plan called for launching both spacecraft within a 39-day period on slightly different trajectories so that both would arrive near Venus within a one-day period, Dec. 8-16.

NASA has until Sept. 10 to launch the second Mariner. The next time that Venus approaches close enough to the earth for a Mariner launch will be February 1966. The cost of the two Mariner spacecraft designed and built by Jet Propulsion Laboratory under a 10-month cost-plus-a-fee contract is approximately \$12 million.

Egypt Fires Missiles; Claims Range of 360 mi.



Missile launch photos possibly show several different launchers rather than a sequence of one launch. Missile was reported to have struck a target several hundred miles away. Egyptians say the missile is about 50 ft in length and has a range of approximately 360 mi. UAR President Nasser also mentioned the opening of a jet aircraft manufacturing facility last week. Factory will manufacture jet engines and aircraft for Egyptian aircraft, fighters and troop transports.



Cessna Model 411, larger aircraft in the Cessna line, is in initial stages of flight testing of the company's Wichita, Kan. factory. Shown above with a 1000; the 411 is in the 1,000 lb. plus category and will carry 6.8 persons. Span is approximately 40 ft., height to tip of its covelet 11 ft. and length is about 33 ft. (AV: July 25 p. 27).

Supercharged Cessna 411 Begins Flight Testing



Model 411 prototype is powered by two Continental C180/120 turbo-supercharged, fuel injection engines, rated at approximately 160 hp each. Oval windows and air scoop at base of vertical fin indicate the aircraft is designed for certified pressurization. Integral steps are contained in the lower section of the two door doors. The top half swings up to provide easy access.



Gen. Taylor to Head Joint Chiefs; Lemnitzer Named to Head NATO

Washington—Reinforced emphasis has been placed on the ability of the U.S. to wage low-intensity nuclear war by President John F. Kennedy's nomination of Gen. Maxwell D. Taylor as outgoing advocate of stronger conventional Europe, as chairman of the Joint Chiefs of Staff.

At the same time the President nominated Army Gen. Lyman L. Lemnitzer, present JCS advocate to select Air Force Gen. Lauris Norstad as outgoing chief of the U.S. European Command. The North Atlantic Treaty Organization permanent council also named Gen. Lemnitzer to replace Gen. Norstad as supreme allied commander of European forces.

Gen. Taylor has been President Kennedy's special military adviser since June of 1961. Gen. Taylor retired in 1959 as Army chief of staff in a disagreement with former President Eisenhower over role and independence of the State. He has in fact a single chief of staff for the armed forces rather than the joint chiefs system.

One key reason for Gen. Taylor's selection is to provide forceful leadership of the joint chiefs which is composed of USAF Gen. Curtis E. LeMay, Navy Adm. George W. Anderson, Army Gen. George H. Decker and Marine Gen. David M. Shoup.

Gen. Lemnitzer has been doing an increasing amount of traveling with Secretary of Defense Robert S. McNamara to U.S. and foreign bases. When he is absent from a meeting of the joint chiefs, Gen. Decker presides in some cases in terms of access as a member of the joint chiefs. There has been an increasing lack of agreement in such meetings.

Gen. Decker will be replaced as Army chief by Gen. Earle G. Wheeler who is now Gen. Norstad's deputy as USMC.

Both Decker and Norstad will retain all of the changes will take effect on Sept. 10.

If Gen. Taylor finds over a period of time that there is increasing disagreement within the JCS, he probably will use the so-called his argument for a single chief of staff over Pentagon observers believe.

The nomination of Gen. Lemnitzer drew pointed reports that he was in a position to lead the administration President Kennedy's move to his defense in a new conference last week, saying that he had informally determined that the NATO nations would accept neither American nor supreme allied commander. "We then went to the house of Gen. Lemnitzer, who is our senior military officer and a distinguished one."

A high Administration source told Associated Press that five stories about Gen. Lemnitzer were circulated that the Central Intelligence Agency in the spring of 1960. These stories said in effect that Gen. Lemnitzer and the joint chiefs had failed to support the mission.

These accusations had no effect, because Gen. Lemnitzer made no attempt to refute them. By January of this year it was determined that he had had nothing to do with the planning of the mission, although the joint chiefs were called in at the time. When asked by the President why he had not protested about these stories, Gen. Lemnitzer said he had a job to do which did not include reacting to criticism.

Gen. Norstad's resignation was refused last February, but stood on at the request of the President until the top-level shifts were announced. On the same position facing NATO, one of the most difficult that Gen. Norstad has had to deal with is the proposed mobile mid-range ballistic missile.

When the concept was first proposed, it called for a 13,000-lb. truck-mounted missile that would be fired from points in the NATO countries.

But last summer, however, strong objections had been registered by most of the NATO nations about having no strong weapons in their own hands. The ability of Russia to fire ballistic missiles with 108,000-lb. warheads lost strength to the arguments of the nations within each country which favored disarmament and said that nuclear weapons would intensify nuclear arms races between Russia and NATO.

All NATO countries but Germany were said to have accepted the road-based version of the MMRBM and favored a subvised version instead.

Then talks were made stronger by U.S. demands that they pay for a greater share of the cost of this new weapon system. If they had to pay, they wanted a greater role in the development of the system.

Gen. Lemnitzer will be faced with the task of persuading the NATO nations to pay for a greater share of all weapon costs. This is desired by the continuing unfavorable balance of trade being experienced in the U.S. He already has been active in the effort, having accompanied Secretary McNamara to Europe for several conferences.

Other top-level shifts face the U.S. military services. It was indicated that Gen. Earle G. Wheeler, Army chief of staff, would be replaced and would be sent to fill the post vacated by Gen. Wheeler. Army Gen. James E. Moore, chief of staff to Gen. Norstad in the NATO command, is due to retire this fall.

In the Navy, Vice Adm. Robert D. Pyne, deputy chief of naval operations for air, has requested retirement after two Nov. 1. He has held the post for more than 10 years. Vice Adm. Thomas H. Moorer, head of the Navy's Long-Range Operations Group, probably will be ordered to command the U.S. Seventh Fleet in the Western Pacific. Vice Adm. William A. Schenck, now Seventh Fleet commander has been promoted as the replacement of Adm. Price.

Rear Adm. Paul D. Wright, chief of the Bureau of Naval Weapons, is slated to become the commander of the Pacific Fleet. He probably would be relieved by Rear Adm. Kibler S. Masterson, his present deputy.

Adm. Robert E. Denson, NATO supreme commander, Atlantic and Pacific, is scheduled to retire next April. He will probably be replaced by Adm. H. Page Smith, commander of U.S. Naval Forces, Europe, who in turn would be replaced by Adm. Charles E. McDowell, commander of the Sixth Fleet in the Mediterranean.

Yeager Appointment

Cdr. Charles E. Yeager, test pilot to the president in the Bell X-1 in 1947, was named commander of the USAF Aerospace Research Pilot School on July 24. Cdr. Yeager succeeds Lt. Col. Robert M. Howe who has been transferred to Portugal in the office of the director of missile acquisition, DCS/Missiles and Logistics.

As commander, Cdr. Yeager heads the Aerospace Research Pilot School with the mission of training selected pilots to acquire and conduct flight tests of aircraft, experimental or production type aerospace vehicles.

Man's Mission

Man's role in USAF's future aerospace mission will be investigated by Aeronautics Division of Paul M. C. under a small, current contract from Aerospace Mission Division's Research and Development Laboratory at Wright-Patterson.

Concepts will include such tasks as: how to be equipped by both ground-based and aerospace means and present the tasks they can perform in an effort to define the role of man in aerospace systems. Typical advanced systems to be reviewed include command, control, strategic control systems, space plants and space logistics and rescue systems.

New Soviet Nuclear Test Series May Force More U.S. Experiments

Washington—Soviet Russia's decision to conduct another series of nuclear weapon tests could force the U.S. into more testing, President Kennedy said last week.

The announcement of the Soviet test series had made a "favorable" first test Russian tests be held, particularly since the U.S. had "succeeded to enter space the same way" by exploding a nuclear device at a very high altitude.

Two days later Kennedy also announced that his Northern Fleet and nuclear and air forces will test modern weapons in the Barents and Kara seas between Aug. 5 and Oct. 31. These exercises are scheduled with adequate notice to head state—probably including operational testing of nuclear warheads for Polaris-type, submarine-launched missiles.

Secretary Niels Khrushchev assigned the Northern Fleet and on July 21 received the launching of rockets from submerged, nuclear-powered submarines, the official news agency. This and Russia has claimed that the type of weapons being lost but never publicly referred to underwater launchings until now.

AVIATION WEEK revealed last Aug. 1 (p. 15) that Russia had completed its advanced test launchings of a solid-propellant missile from a nuclear-powered submarine. U.S. Navy officials at that time were still doing publicly that Soviet nuclear tests had no effect on their policy toward nuclear tests.

President Khrushchev extended orders to Rear Adm. Predko, commander of the Submarine Fleet of the Northern Fleet, Captain Sergei Chibrikov, commander of an atomic submarine, and Engineer Captain Second Class Timofeev, commander of a second class nuclear submarine, to conduct an atomic submarine. "This said, 'In accordance with the special task set by the government'."

That special task is believed to be research and development tests of Polaris-type missiles in the White Sea area. Russia missed a thirteen-volume U.S.-USSR nuclear test agreement last September to begin a series of tests that 50 nuclear tests on the continent and on the Arctic island of Novaya Zemlya, which lies between the Barents and Kara seas. The series included one device with a yield of more than 50 megatons.

President Kennedy noted that "in this constant pattern, economic drains to the U.S. will be less. It is not our test series unless we are forced to do so as we are now threatened or be-

come as a result of the new Soviet tests. We had ourselves unable to meet our commitments to our own people and those who are allied with us. We will therefore have to wait.

Meanwhile, the U.S. held again July 25 in its attempt to explode a device at less than one megaton yield at an altitude of 10 to 60 miles above Johnston Island in the Pacific where the Poseidon might test fire on the launching pad.

This meant at least a two-week delay for preparations of the pad and another booster.

Fast high-altitude thermobaric devices, in the previous stage, was completed at about 200 mi. altitude last July 9. In earlier attempts, one that had been destroyed because of a fire tracking signal and another that disappeared. The thermobaric device was being tested by the special test configuration (AW July 9, p. 27).

Technical Data Shows Telstar Status Perfect

Washington—First technical details on the performance of the Bell System Telstar after 150 orbits indicate that its communications satellite is in excellent initial condition and operating "just normally," according to Bell Telephone Laboratories (AW July 16, p. 36).

The satellite, whose orbit kept it continuously exposed to sunlight up to July 21, will spend increasing periods in the earth's shadow after Aug. 16, after which the orbit will reverse.

Use of the satellite, which could be operated for up to 3 to 50 min. per day without discharging its batteries while in full sunlight, will be gradually reduced to slightly less than 2 hr. per day due to damping from earth's magnetic field. This should provide sufficient stationkeeping for at least a year, based on present rate. BTL said.

Telstar, in within range of the Andover, Mass., station ground station at the time data orbits, and during two or three of those it is also visible to the stations in Britain and France. The satellite has been used for communications and television on weekends during an average of three hours per day, but is tracked and its

Quantatron Officer

Alfred Charnock Jr. was conducting an offer from Union Carbide Corp. but work for the guidance of its subsidiary, Quantatron, Inc., Santa Monica, Calif., a research and development firm located in the area assigned, Quantatron would become part of Union Carbide's Los Angeles, an official news outlet. Quantatron's parent was Union Carbide, headed by Dr. Theodore Mann, is one of the largest in the country, partly headed by the other services.

Other services companies including Monsanto, American Cyanamid, and General Electric. Quantatron was selected to develop the Los Angeles area.

national performance telemetry data is monitored by Andover for all passes within range of the station.

Maximum velocity here is Andover per day has been 150 mi., with up to 100 mi. per day of orbital velocity for U.S. and European observers. One-to-one orbit per pass, the orbital velocity interval will change, reaching a maximum on Aug. 29, then slowly decreasing, with the orbit repeated every 108 days.

Telemetry data indicates that orbital velocity is as expected. Discontinuity of solar cells used to measure Van Allen radiation effects is within 2% of expected value based on other cell counts.

The satellite functioned perfectly last week during several low transmission attempts. During one attempt, the audio portion of the program was lost briefly, but the satellite from an error in switching was the ground.

Defense Salary Policy Explained by Brown

Washington—Defense Department's policy on contract allowances for executive salaries is already in line with the suggestion advanced by the Defense Administration in April (AW July 9, p. 18). Dr. Harold Brown, director of defense research and engineering, told the House military operations subcommittee last week.

He pointed out that Defense regulations provide for reimbursement of "reasonable" salaries and other compensation, and that the reasonableness is judged by the comparison with the compensation of other persons in the same job or responsibility in private business.

Brown noted that these two criteria—"reasonableness" and "comparability"—are also recommended in the report dated May 2, 1962, by the Defense Administration (AW July 9, p. 13) and submitted by the President to the Congress.

Lunar Bug Contract Due by Mid-October

By Edward H. Kolman

Washington—Private definition of many of the major subsystems in the Apollo lunar landing vehicle which will take two astronauts to the surface of the moon will be made in January when a joint industry-National Aeronautics and Space Administration Phase I design study of the bug will be completed.

Contractor competition for development and fabrication of an Apollo lunar landing bug begins July 23, when 1) announce competition received proposal requests from NASA's Manned Spacecraft Center in Houston. A bid will be received by NASA on August 2, and bids will be due Sept. 9. NASA hopes to award the two-part contract to a single company by mid-October.

The plan will be a 90-day study. NASA will specify design parameters and the major subsystems, according to John Disher, assistant director for the Apollo program at NASA's Office of Manned Spacecraft and Flight Management. Second phase will be hardware production.

NASA's main bidder last (AW July 23, p. 35) consisted of Boeing, Douglas, General Dynamics, Convair, Grumman, Long-Term-Vought, Lockheed, Martin and Northrop. These companies are also competing for the lunar orbit rendezvous study contract, which was won by Long-Term-Vought-McDonnell, North American and Republic last week. The last contract was for a proposal to develop a lunar orbit rendezvous vehicle.

It is expected that North American designed itself at NASA's request because the company's Space and Information Systems Division has the joint Apollo ascent and service module contract, and will manage the bug with the remainder of spacecraft's system. It is expected the firm received the request for proposal only for information. McDonnell is a joint contractor for the bug.

Lunar Bug Guidance

Washington—Manufacturers Institute of Technology will develop the guidance computer system for the Apollo lunar landing bug as a part of an estimate with NASA to develop the transition guidance and navigation system.

Original MIT Apollo guidance computer system was a 100,000 lb. machine which would be used in the lunar landing module because both systems will be designed to use common components, reducing the types of parts to be used on the land.

The three-core, 100,000 lb. 20th Mar. 1962, mission, and the bug will be the Gemini spacecraft. Commercial pressure for spending the NASA contract (last week) is expected. McDonnell, Republic and others of the original eight firms on the list do not have suitable NASA contracts.

Being a booster contractor for the Saturn C-5 vehicle.

Being a former 360 man team under Harrison Goldberger (the project). Goldberger, a former head of the company's Space Station Department and also vice president for the Advanced Research Project Agency.

NASA (headquarters) manager for the lunar landing will be Mr. Richard C. Hoover, who also is Apollo guidance and navigation manager. Project chief at Houston, not yet named, will work under Apollo Project Director Charles Felt.

Several of the general vehicle requirements are described in the proposal to build, but most of the vehicle design will be made late in the study.

The bug will be a 100,000 lb. vehicle in order to provide a safe margin within the Saturn C-5 launch vehicle capabilities. Bug weight will be limited to 20,000 lb., and NASA would like to reduce this weight to 15,000 lb. (AW July 9, p. 25).

Engine structure will be of maximum strength weight ratio but must be able to withstand the stresses of the lunar surface temperature, which was from a 100° to the surface and back side of the bug. The bug will have an atmospheric load, NASA looks on the extreme cold as structural problems.

Because the bug will not be constructed by drag, its configuration will be designed to have low drag. The bug will be a 100,000 lb. vehicle, as mentioned in an emergency mission, for use at the start of the mission, and in the event the fuel cell malfunctions.

The lunar landing station will dry down the surface pressure to 10 in. Hg before the order the bug. During the transition flight, all three engines will move forward until eventually the case is there and the Power Western flight. Plus all other systems to be operating outside the bug at one time.

The bug will be designed with enough fuel so that it will be able to land in the rendezvous, but the emergency mode will be able to revert its role as target and become the chaser.

The bug on the bug will provide 5.5 ft. clearance between the bottom of the bug structure and the lunar surface. The method of landing shock absorbers is still undecided, but it is expected to be based on a hydraulic or pneumatic system like a 500 lb.

The desiccated surface of the moon will operate over a full range of about 1,500 ft. to 10,000 ft. if a single landing engine is used. If multiple engines are utilized, they will probably be stopped over different stages. Propellant will be specified in an emergency mode, which is an emergency mode, which is an emergency mode. The vehicle will have a 16-minute maximum coast time. The vehicle will be a 16-minute maximum coast time. The vehicle will be a 16-minute maximum coast time.

As before, it is expected to be two hours and fuel cells too complex, there is a good chance that power on the moon will be generated by a fuel cell. The fuel cell will be a 16-minute maximum coast time. The vehicle will be a 16-minute maximum coast time.

Environmental control system probably will be performed after the moon mission, and in the Moon mission. Superheated steam engine will provide the heating oxygen and cooling probably will be in boiling water. Carbon dioxide removal will be accomplished with lithium hydroxide and charcoal will be used.

Docking system will be provided by the command module fuel cell system. Present estimates are that this system will generate about 250 ft. of water. The docking system will be a 16-minute maximum coast time. The vehicle will be a 16-minute maximum coast time.

The lunar landing station will dry down the surface pressure to 10 in. Hg before the order the bug. During the transition flight, all three engines will move forward until eventually the case is there and the Power Western flight. Plus all other systems to be operating outside the bug at one time.

Life Sciences Contract

Washington—Learner Foundation for Medical Education has been awarded a \$245,000 contract to complete a deficit in the number of astronauts on the moon. The contract is for the purpose of life sciences on the Saturn 1 mission. The contract is for the purpose of life sciences on the Saturn 1 mission. The contract is for the purpose of life sciences on the Saturn 1 mission.

NASA May Dictate Economy Measures

Washington—Space industry contractors may be required to follow fairly detailed fabrication techniques when the National Aeronautics and Space Administration cancels back its more conventional hardware production.

NASA Marshall Space Flight Center stands in insisting that contractors in some cases employ production techniques which are "self-insure to be lost," according to Dr. J. R. McCall, assistant to Marshall vice President, Marshall director.

Dr. McCall's statement came during hearings by the House Committee on Science and Astronautics on what NASA and the Defense Department are doing to reduce the growing costs of space research and development. While both agencies agreed that research and development does not lend itself to highly competitive contracts, spokesmen insisted that economies are being effected in their contracts.

Defense Department methods, according to Dr. Lawrence L. Korman, special assistant for space to the director of defense research and engineering, is to be highly selective in contract development, and then to standardize as many of the components as possible. Dr. D. W. Wright, director of NASA programs, said his agency is attempting to change contractors' approach to business methods, including techniques, branching methods, spacecraft utilization, use of Defense Department resources and integration and checkout plans.

Some committee members objected to what they considered generalities in Dr. Korman's testimony, and Ray K. Heibler (D-W. Va.) remarked that the statement he could give concrete examples of standardization in the Defense Department. Dr. Korman re-

sponded that Agency B. Altman and Tim use the first three standard launch vehicles, and instead are now being made to make major subcontracts in these vehicles.

The toughest problem, he said, is that contractors dictate standardization in contract, while project specialists want each system built-made for their own equipment.

Dr. Korman said he feels the NASA program is valid and the civilian agency has made the proper selection of launch vehicles for its program. He said that the fundamental responsibility for economy in space programs rests with the integrity of managers and those who work on the job.

He said it is imperative that contractors be used in selecting vehicles for development because the quality of management in both government and industry has "tended to decline." He stated that to the "exploding technology" of space exploration, which has grown faster than the supply of experienced and competent professionals in the field.

Dr. McCall's testimony included a summary of three advanced fabrication techniques, some of which may be made standard for Marshall contractors. •Modular, as self, testing, in which fabrication is done in large chunks and sub-units are used for testing in stead of total and heavy fixed within. •Highly efficient launching techniques, using electrical discharges, magnetic discharge and explosives (AW July 2, p. 8).

•Elasticity built-in design, in which loadable pressure is applied directly to a sheet in place in such a way as to eliminate the need for heavy load-bearing parts. •Numerical control machining, using pre-programmed tape to control the more exact of a cutting tool.

•Welding, cutting, fabrication and positioning in vehicles with a rotating turret support, tilt angle of the solid load and tool were noted.

Wright said the contractors that cost review should not be considered an exercise with wasteful procedures. Cost reviews, he said, stem primarily from direction of sub-tasks which were not known when a contract was let for a job.

He said NASA has authorized a program of cost reporting in five of its largest contracts. Concept it to break the price contract into identifiable components of \$100,000 in value.

Cost of NASA's launch vehicles, he said, is the probability of business and technical people who are able to exert to fix cost options.

Robert W. Beckett, NASA procurement chief, said he knows of no profit windfalls by space agency contractors, and he captured the only, say profits could become excessive would be if both NASA and the contractors greatly overestimated the complexity of a project.

As an example of new techniques aimed at economy in launch operations, Maj. Ross Fortney, NASA chief of heavy launch vehicles at the Atlantic Missile Range, observed the vertical assembly except for the Saturn C-5 vehicle (AW July 12, p. 31) with the pad assembly the agency is using to launch the Saturn C-5, Saturn II and Complex 39, with a turbine-mounted shed and load pads, one launch 36 advanced Saturn vehicles, and they can be of a variety of sizes and configurations. Complex 39 will cost \$450 million and can accommodate the Saturn launch site with a force of 1,100 men, he said.

And assembly technique, as a test at Pad 34, would require some launch pads, he said. The Saturn II will be built to contract and require a support power of 3,700, Fortney told the committee.

Fortney noted that Complex 39 is being designed to accommodate solid-propellant first stages.

Aircraft Designations

Washington—Director establishing a common system for designations for all military aircraft has been established by the Defense Department. The program was recently discussed in a report in Aviation Week, June 18, p. 26.

In one more change, the director made an attempt to eliminate the various designations of fighter aircraft which had appeared in the original draft. This program would have made the McDonnell F-101 the first fighter to be designated under the new system.

The director also was to be the more technical models which appeared in the first draft. Portfolios of this list are in the Air Force, which is the authority for all aircraft, which is the design authority. When this list is eventually published is an appendix to the director it will contain the symbols of several service manufacturers not included in the original list.

On July 1, 1965, the new July 1 is entitled "Designation, Re-designation and Naming of Military Aircraft." It has not yet been decided if the system will apply to current aircraft. As Fortney Beckett is making no effort to enter the track airline field, Fortney and he also said that mergers within the local



ARTIST'S DRAWING shows BAC 111 transport in Mohawk Airlines livery. Mohawk selected one of the jet aircraft from British Aircraft Corp., and has three on order. Short-range transport is powered by two Rolls-Royce Spey turbofan engines.

Mohawk to Use Private Financing In Purchase of Four BAC 111 Jets

Washington—Purchase of four British Aircraft Corp. (BAC) 111 transports by Mohawk Airlines will be handled through private financing without the aid of the Civil Aeronautics Board's financial loan plan. Robert E. French, the carrier's president, told Aviation Week last week.

About 50% of the financing will be through long-term bank and insurance company loans. French said. The balance will be handled through equity financing, he added. Cost of each aircraft to be purchased by Delta-Texas Spec. 2, turbofan engines will be \$2.5 million.

Mohawk has taken an option on four more 111s to supplement the one it already has, which represents the first firm order for jet aircraft for a local airline carrier. Deliveries will begin next in 1967.

Initially, the BAC 111 will operate from Mohawk's major terminals of New York, Philadelphia, Cleveland, Detroit, Buffalo, Boston and points within New York state. Hartford and Washington, Vermont will also receive the new service. French stressed that scheduling at first will be tentative and added:

"We expect that there may well be changes in our routes as we anticipate continuing improvement in traffic. We will constantly re-evaluate markets before now and 1967 for optimum jet scheduling."

French said that one of the carrier's prime goals at center planning is establishing Washington, and later Chicago as terminal points. Mohawk is making no effort to enter the truck airline field, French said. He also said that mergers within the local

service airlines will inevitably be one factor in placing these carriers on a sub-tail line.

French is noted for his stand against the federal principle as well as his opposition to the government loan plan. He believes that purchase of aircraft through guaranteed loans during a carrier's period of "financial crisis" is far better than new aircraft. French is also opposed to the recent Act of Local Transport Aircraft action in selling its aircraft assets that have been open since (AW June 18, p. 25).

French said he desired to keep the turbofan aircraft because it would be available to not at Mohawk's south. "On the other hand," he said, "the government guaranteed money on that the BAC 111 will be economically preferable on our routes with a total cost less than the price of the Conquest and the Conquest."

Mohawk will continue to operate its five Conquest 440s, 14 Conquest 440s and 10 Martin 404s with the BAC 111 which will be equipped with 55 percent go-into. At maximum temperatures, the aircraft will operate fully loaded with 1,000 ft. of cargo over typical short-range ranges of 155 mi.

The aircraft will be equipped with self-contained engine drive, low fuel and low cost, and a self-contained power unit. An auxiliary turbine power unit will provide power for engine starting and air conditioning.

British Aircraft Corp. has sold its BAC 111 transport to British Airways, with an option for an additional five, right to be manufactured here, and 10 with an option for five more to British United Airways.

News Digest

House-Senate confers first work authorized a \$3.1 billion Fiscal 1965 program for the National Aeronautics and Space Administration—NASA. The House Administration requested (AW July 16, p. 31) Appropriations bill must be approved by Congress.

Cable no-launched probe lifted a 110 ft. atmospheric balloon to an altitude of 1,000 ft. over the Pacific Missile Range as Project 111-10 to measure on density at extreme altitude. Project was directed by Naval Research Laboratory. Core of the instrumented probe was equipped with spectrometers. Cable is a prototype aircraft developed and built by Naval Ordnance Test Station, China Lake, Calif. In Project 111-10 it was launched by a McDonnell F4H.

Launched Project 111-10, Redfish, Calif., has fired a 12-in. solid rocket motor loaded with 150 lb of Polaris-type 547 propellant at a temperature of -70°.

Soviet Pulsed Observatory claims it has obtained the first infrared photographs of the lower surface. They are said to show, extraterrestrial clouds. The observatory has a bank of 20 photogalvanometers with a semiconductor television tube in the 0.9 to 2.3 micron range.

As Power-Mixing Type 2 ICBM, loaded with 10,000 lb of AM-10 in a planned 5,000 mi. flight, left several hundred miles west of the target area. An F-106 and the test flight also carried many of its objectives.

Marshall Space Flight Center has begun static test runs of the Pratt & Whitney J58-P3 engine to facilitate personnel with flight design engineers. Calif. has been, produced the engine's first test run (AW July 12, p. 8) and generated 15,000 hp thrust.

Soviet Speed Claims

Moscow—Soviet Union has issued reports of testing the absolute world speed record of 1,600 mph. The test was done by a MiG-21. The MiG-21 is a single jet C-56 fighter on a 15 ft. low cruise July 7, according to the newspaper Sovetskaya Russia.

The newspaper stated Moscow is setting up for flight (AW July 25, p. 25). "We have already which even today is ready to crash but the new average speed record (1,600 mph) and the top speed of over 1,600 mph per hour (1,600 mph) which was achieved on a test of its approach runs."

Trunkline Industry Profit Hopes Still Dim

Washington—U.S. domestic trunk lines are expected to show a 5% increase in revenue passenger miles this year, compared with 1961's gain of 1%, but chances are still slim that the industry will end the year with a profit.

Because a series of labor strikes during the first few months of 1961 made any comparison of the two successive periods meaningless, airline statisticians have found it extremely difficult to gauge the actual progress made by the industry this year. Confusion that has been caused are discouraging traffic growth is not yet sufficient to make the industry out of the red.

Industry needs do not necessarily reflect the status of individual carriers. The majority of the trunklines will end the year with net earnings, but the substantial losses anticipated for the remaining airlines will undoubtedly wipe out those gains on an industry scale. This was the pattern set in 1961, when seven of the 11 carriers showed a profit but the industry recorded a total loss on domestic operations of \$34 million.

It was hoped that June would serve

as some indicator of current traffic activity, but the flight engineers' strike against Eastern Air Lines beginning June 21 again clouded statistical findings. Because Eastern has handled only about a 10% of its passenger traffic figures for the three weeks of June before the strike have not been fully compiled.

Revised Total

Assuming that Eastern, under normal operating conditions, would have experienced a traffic growth comparable with the rest of the industry, domestic trunk lines probably would have shown a 5% gain in revenue passenger miles in June rather than the estimated 4% actually reported (AWF July 16, p. 47).

Then compared with the 11% or more increase reported in each of the seven months from November through May, a figure well below the monthly 15.16% increase registered repeatedly during much of the 1950 decade.

Traffic growth now double digits throughout the balance of the year. An airline's gross national product has not

shown as healthy a climb this year as was originally indicated by the Kennedy Administration. Since the airline traffic growth rate closely parallels fluctuations in the gross national product (AWF Feb. 28, 1961, p. 38) the slower economic recovery from last year's national recession would depend on the business doing the best in months.

Nevertheless, traffic gains sustained during the first few months of 1962 will bolster the year-end figure so that the production of a 5% increase appears safe even in the face of a post-summer quarterly period. This can hardly be termed a spectacular start and, in fact, is a cause for deep concern.

In addition, industry load factors continue to tumble and have failed to show above 80% in any of the past 22 months. In June, the load factor did drop to 57.5% from 54.4% in May, but this can be attributed to the absence of strike-bound Eastern's services during the last seven days of the month.

Each of the big four carriers—American, Eastern, TWA, and United—presented a load factor decline in June.

During the month, TWA's revenue passenger miles at both first-class and coach categories declined.

The industry's coach load factor in June dropped to its lowest level in years. Indications are that the trunk lines, so far this year, have lost a large number of non-business travelers—generally coach passengers—to other forms of transportation, and that the proportion of business travelers to the total number of passengers is increasing steadily.

Nevertheless, coach revenue accounted for 51.9% of total revenue passenger miles during the first six months of this year, compared with 51.8% in the same 1961 period. Many observers are concluding that many business travelers are continuing to switch to coach service. This change, coupled with a low oil cost, may have helped to offset drops in 1961's coach revenues.

Domestic revenue passenger miles fell to 1 billion in June, 13.5% below the 1.15 billion generated in June, 1961. The industry has suffered a consistent decline in this class of service for the past two years.

Monthly first-class load factors in June rose slightly over May to 52% from 46.9%, but the figure was 5.9 points below the June, 1961 level. In only two of the past 12 months has the first-class load factor reached or surpassed 50%.

Translators have estimated first-class load factors in hopes of restoring a profitable load factor in this class. The volume of seat miles of first-class seats during the first part of 1962, but with this exception, first-class seat miles have regularly shown a

North Atlantic Scheduled and Charter Traffic—1961

| | (Summary) | | | % Change over 1960 |
|--|-----------|-----------|-----------|--------------------|
| SCHEDULED OPERATIONS | | | | |
| | Estimated | Workload | Both Ways | |
| Flight Miles | | | | |
| January | 1,112 | 1,320 | 3,332 | +16.4% |
| March | 13,617 | 15,616 | 20,563 | +13.4% |
| Total Passenger Carriage | 18,026 | 18,164 | 26,166 | +11.4% |
| April | 8,184 | 1,410 | 4,056 | +10.4% |
| Total | 37,144 | 37,254 | 24,220 | +13.2% |
| Seating Capacity | | | | |
| April | 324,328 | 327,362 | 682,712 | +12.4% |
| May | 1,528,468 | 1,535,952 | 3,093,742 | +14.4% |
| Total | 1,852,796 | 1,863,314 | 3,776,452 | +14.7% |
| Revenue Passenger Miles | | | | |
| April | 125,547 | 131,633 | 264,678 | +16.0% |
| May | 792,122 | 872,677 | 1,674,344 | +13.0% |
| Total | 917,669 | 1,004,310 | 1,939,022 | +13.0% |
| Average Load Factor | 48.4% | 55.0% | 51.2% | +13.0% |
| Carriage (Load) | | | | |
| Passenger Weight | 18,126 | 17,685 | 36,146 | +13.0% |
| Cargo Weight | 12,143 | 11,724 | 23,447 | +11.1% |
| Total | 30,269 | 29,759 | 60,455 | +14.5% |
| Mail (Load) | 12,439 | 7,632 | 20,126 | +13.0% |
| CHARTER | | | | |
| Flight Miles | 1,347 | 1,584 | 3,723 | +18.4% |
| Passenger | 107,285 | 109,156 | 254,478 | +13.5% |
| Cargo | 712 | 1,207 | 2,792 | +12.5% |
| Mail | 7 | 4 | 11 | +6.7% |
| ALL OPERATIONS | | | | |
| Flight | 18,495 | 16,469 | 34,559 | +14.5% |
| Passenger | 1,025,322 | 1,128,565 | 2,173,114 | +13.5% |
| Cargo | 34,730 | 29,844 | 58,205 | +12.5% |
| Mail | 13,500 | 7,636 | 20,119 | +13.5% |
| Estimating & Statistics Section ATA's Domestic Department | | | | |



YS-11 Readied for First Flight in August

First flight test of Japan's YS-11 turboprop, developed by Nakai, is scheduled for late August from Kurehiko Airport of Matsuyama. Initial flight was originally scheduled last May (AWF May 12, p. 295), but fatigue tests are still being conducted in Tokyo's National Aeronautics Laboratory and static tests at Kurehiko.

Ethiopian Jet Order

New York—Ethiopian Airlines has announced its Boeing 720B order and will take delivery of two aircraft later this year. It plans to inaugurate jet service Jan. 31, 1963.

Ethiopia's jet acquisition has been delayed by lack of airport development at Addis Ababa's principal city. Addis Ababa and Addis Ababa of the airport, covering 7,000 ft., accounted money estimates for jobs.

The two 720B replace two outdated aircraft in Ethiopia, but which went to Sen's Airline Airlines when Ethiopia's aircraft were sold. The aircraft are being financed by the Export-Import Bank, which the Development Loan Fund of the State Department is extending to help them for export to Ethiopia development.

Ethiopia will use the jets to link Addis Ababa with Addis Ababa and Addis Ababa to Addis Ababa. The aircraft are to be financed by the Export-Import Bank, which the Development Loan Fund of the State Department is extending to help them for export to Ethiopia development.

KLM Loss Increases During First Quarter

The Hague—KLM Royal Dutch Airlines showed annual financial losses, but reported losses of \$11.2 million for the first quarter of 1962 as compared with a \$5.5 million deficit for the same period of 1961. Total revenue was placed at \$56.5 million, each month rose, Jan., 1960. Available, each seat miles, however, has increased rapidly to meet the growing demand. In May, a sizable coach seat order placed the 1 billion point for the first time, a 13% increase over the previous May. The volume declined a little in June but was still 20% higher than that offered in June, 1961. Revenue passenger miles in both categories of service, totaled 3.1 billion for the 12 months ending June 30, a 7.6% increase over the previous 12-month period. Domestic revenue passenger miles for the 12 months reached 57.3 billion, an 18.6% gain.

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A KLM official said at least part of the decline below the 1961 level could be attributed to the acquisition of the Dutch Airlines in March, 1961.

The airline, with estimated 1961 losses of approximately \$20 million, has asked for government aid to help increase its present difficulties and complete planned expansion of routes (AWF Jan. 3, p. 41). The government, in turn, recently asked permission to authorize loan guarantees for KLM of up to \$104.6 million between now and the end of 1963, plus direct loans for the airline of \$10 million over the same period.

Atlanta, meanwhile, reports that it is joining the select group of North Atlantic carriers who showed a profit during 1961. First figures show the carrier added some \$1.5 million to its net profit for the year of \$10,580.

AIRLINE OBSERVER

► Watch for purchase of two de Havilland Trident 321 jet transports by Kuwait Airways. Negotiations were in final stages last week, with funds for the aircraft already made available by Kuwait government. Sixty will be first outside Coast Britain 24 have been ordered by British European Airways. Kuwait Airways also is talking to British Aircraft Corp. about possible purchase of three BAC 111 twin-jet transports.

► Top gross weight for the Boeing 727 has reached 151,000 lb. Aircraft was originally designed for maximum gross weight of approximately 135,000 lb., but weight increased as added cargo and payload were requested by purchasers. Standard 727, without extra fuel capacity, has gross weight of about 145,000 lb., but most orders are for heavier models.

► KLM, Royal Dutch Airlines, has signed an interline agreement with the Red Chinese airline, CAAC (Civil Aviation Administration of China). Under the agreement, both carriers will exchange transport documents and passenger tickets and will receive through space on connecting flights. KLM connects with CAAC at Rangoon.

► Russian Tu-114, which arrived in Havana recently on a survey flight from Moscow (AW July 23, p. 38), made the 10,000-mile trip in about 21 hr. flying time. The run from Moscow to Conakry, Republic of Guinea, took approximately 11 hr.

► Republic of Guinea has announced construction of its new airport at the capital city of Conakry is complete. The field, described in one of the most modern in Africa, was built with Soviet aid and was officially opened with the landing and takeoff of Russian Tu-114 Moscow-Havana survey flight. Russian press hailed completion of the field "practically an miracle." It quoted Guinea officials as stating that achievement of the new airport "reflected long, unbroken efforts by the Guinean people persistently indicating that construction had bogged down."

► CAT (Civil Air Transport), Republic of China's flag carrier, has ordered two de Havilland of Canada DHC-45 Caribou STOL transports for immediate delivery. The two aircraft are the first of the Caribou model to be produced by a civil air carrier.

► United Air Lines will review overhead procedures for the Douglas DC 8 and Boeing 720 aircraft at the carrier's San Francisco maintenance base. United wants to reduce work load and cost expenses.

► Boeing 727 tailfin transport will be equipped with side-angle lens periscope in the cockpit door to provide crew with a view of the passenger section. Device was actually proposed to guard against passengers at the forward drinking fountain being struck by the opening door, but was made standard equipment following series of aircraft hijackings.

► Eastern Air Lines' contention that failure of the Civil Aeronautics Board to act as arbiter of the Mutual Aid Pact is then action is applied for federal application (AW July 16, p. 31) is being denounced by Board members. CAB spokesmen point out that antitrust Eastern's strategic competitors—Delta, National and Northeast—are not parties to the pact, and are not required to share with Eastern any profit they gain from the pact. While mutual aid pact would be expected from American and United. National and Delta are the principal beneficiaries of the pact and increased traffic gain of 15% and 25%, respectively, in June.

► Foreign air travelers visiting the United States are primarily affluent businessmen interviewed about U.S. prices, according to a recent survey by the Commerce Department. Of 222 travelers interviewed at Atlanta International Airport, 85% were here on combined business-pleasure trips, and 25% were visiting U.S. relatives. Only 4% of these interviewed thought prices were too high, but 12% complained about the quality of services, facilities and food.

SHORTLINES

► Allghere Airlines has asked the Civil Aeronautics Board for authority to operate flights from Lexington and Louisville, Ky., to Pittsburgh and points in WV, Va. and Ohio. Allghere's present services consist of Pittsburgh terminals at Washington-Baltimore. The airline's plans call for the use of Convair 440 and Martin 201 aircraft on the proposed routes.

► American Airlines will add an Conquest 990 Atlanta flight to its schedule on Aug. 1. As a result, American will be using 990s on half of its daily New York-Chicago round trip.

► Bonanza Air Lines' said its January-June passenger traffic rose 31% and passenger revenues increased 27% over the same period last year.

► Cuban government said it plans to resume domestic air transport services, with first flights from Havana's Jose Marti Airport. Schedules call for three daily round trips to the Isle of Pines, five to Cienfuegos, and five to Santiago de Cuba.

► Delta Air Lines will resume its California New Orleans-San Jose jet service from June to five flights weekly effective Aug. 15. The additional flight will operate Mondays with tourist and first class accommodations on Conquest 380 aircraft.

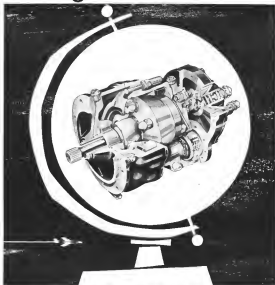
► Five African nations have become members of the International Civil Aviation Organization. They are Republic of the Upper Volta, Malawi Republic, Tanganyika and Republic of the Congo (Brazzaville). Total membership of ICAO group currently stands at 97.

► Northeast Airlines has opened 323 extra flights en route to Florida since the Eastern Air Lines flight suspension strike began. Northeast reported that all of its extra flights were filled to "near capacity."

► Trans World Airlines last week began experimental passenger telephone service (AW June 16, 1962) aboard one of its jumbos operating between Chicago, St. Louis, and the East Coast. The service is similar to conventional telephone charges plus a \$1.50-5.00 negotiated fee.

► White House said to the Senate last week the nomination of Alan S. Boyd for support to the CAB. President Kennedy is expected to re-nominate him Board chairman.

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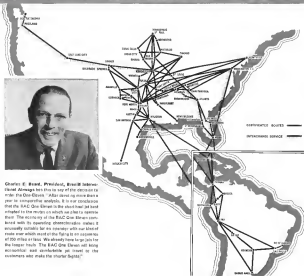
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CHOOSES

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ONE-ELEVEN

THE SHORT HAUL JET



BAC

ONE-ELEVEN

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McDONNELL AIRCRAFT CORP. F-4H Navy fighter has been ordered by USAF, which has obtained two for test and evaluation.

McDonnell Gearing Effort to Handle Tripled

F-4H IS NOW DEPLOYED aboard aircraft carriers of the Navy's Sixth Fleet in the Mediterranean and the Seventh Fleet in the Pacific.



BOUNDARY LAYER CONTROL, permits F-4H to make tighter turns in combat than any other U.S. supersonic fighter aircraft.

Order for F4H

By Larry Woods

St. Louis—McDonnell Aircraft Corp. is expanding its production line to meet tripled demand for the F-4H Phantom II high performance fighter as a result of acquiring a new customer. The Air Force will spend more than twice as much in Fiscal 1965 for the F-4H as the Navy, for which it was originally developed.

Chosen for the two-engine, two-seat Mach 2.5 combination fighter/attack aircraft will stand at almost 500 miles when Fiscal 1965 delivery money becomes available, making a backlog of more than 51 billion. McDonnell will accelerate its progress through increased expenditures, intensive use of existing facilities and acquisition of subcontractors through subcontracting.

High performance of the F-4H, which is powered by two General Electric J79 engines, is proven by a string of records involving high and low altitude speed, altitude, time-to-climb, cross country speed, closed course speed and sustained altitude. This performance was achieved even though Navy requirements demand relatively low landing speeds.

It was more than superb performance that sold the weapon critics. Radar, navigation and fire control systems also proved to be superior and maintenance manhours required for upkeep of the whole system were lower than those of the competitors.

The Air Force was ordered to buy



NAVY'S NUCLEAR-POWERED aircraft carrier, the USS Enterprise, will deploy to the Mediterranean next month with a squadron of F-4H aircraft. North American A-1H is parked ahead of the ship.

The twin-engine Northrop T-38



can take off



climb at 6800 fpm



accelerate to Mach .95



maneuver at 40,000 ft.



and land



on only one engine

On two engines it can climb at 30,000 fpm, fly at Mach 1.35, and reach 56,000 feet

portion of the wing the center of pressure, or lift of the wing, shifts forward making the aircraft tail heavy. In some flight conditions this could cause loss of control leading to a crash.

As the aircraft approaches transonic speeds, downward flow from the wing causes a blocking effect on the stabilizer (downstream disturbance and horizontal stabilizer). With a normal configuration this can aggravate pitchup tendencies.

Roll Coupling

Also associated with high performance wing activity is the phenomenon of roll coupling. This involves a combination of instabilities about both the roll and yaw axes.

These activities were delayed after thousands of wind tunnel tests.

• **Outboard leading edge of the wing was extended 10% to create smooth air flow over the upper surface at angles of attack as high as the inboard portion.** This corrected the change of center of pressure problem.

• **Stabilizer was given 21 deg. of up to a dihedral to make them effective for control despite the wing downwash.**

• **Positive dihedral was needed in the wings to correct the yaw axis deficiencies.** If the whole wing were given 3 deg. of dihedral it would have made engineering complications in the design of the leading gear and parts of the wing. The solution was to put 12 deg. dihedral into the outer panel from the wing fold line.

In designing an aircraft without long tail pipes and shrouds, a host problem was encountered along the lower empennage area. Flow tests in wind tunnel solved this one.

The drooping nose was made mandatory because of visibility constraints encountered in carrier landings when the pilot must have a full view of the deck.

Brute Power

Only slight attention to the area rule, which was developed to prevent aircraft to pass through the transonic regime easily, was included in the T-38 design. The T-38 has to reach high speeds that it can go through the transonic speed regime with only a little help from the area rule.

The T-38's airfoils are non-tapered so that they operate only downward. To produce the opposite reaction for lateral control there are spoilers on the upper side of the wing near the trailing edge. To lower the left wing, the left spoiler would go up and the right spoiler down.

A Central Air Data Computer (CADC), receives all data on air pressure and feeds it to the instrument on radio or line control systems, pilot and engine officer cockpit instruments, the engine inlet ramp control, and the wing flap control.

In order to assure reliability on the

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P.1127 Inflatable Intake Lips Shown

Wind prototype Hawker P.1127 VFRJ clearly shows inflatable lip on intakes to its Bristol Siddeley BS33 engines (inlets right). Inflating the lip changes the contour from the sharp-edged format needed for maximum drag at high speed to a rounded edged shape, approximating the classical "bellmouth" design, which is more efficient in low-speed conditions. Lip action is made of heavy fabric material and is driven via four bands of one P.1127's in production for British Royal Air Force and the U.S.



into the engine inlet at supersonic speeds, a variable sweep was designed to properly position the shock wave to avoid the inlet on each side. The forward part of the canopy is fixed, while the rear sweep is variable between 10 and 14 deg.

FAH Characteristics

There are some of the main characteristics of the FAH:

- Wings are swept back 45 deg at 25% of the wing chord. Wing aspect ratio is 2.52 to 1. The thickness ratio is 7.1% across the span.
- Main wing panels are also flat tanks, or "bat wings." There are also air bridle bag cells.
- Filler leading edge of the wing is

designed for low speed flight, while the inboard trailing portion of the wing is a flap. Besides later control blowing is accomplished by bleeding air from the engine compressors through ducts along the leading edge and the trailing edge flap and when both are dropped. The bleeding begins automatically when the landing configuration is set. This feature permits lower landing speeds and greater maneuverability in combat where tight turns must be made.

- Landing gear wheels are 37 ft 10 in apart. Wing tips are 58 ft 4 in apart. Wingspan is 57 ft 2.5 in. Height of the canopy is 16 ft 3 in and the wing area is 550 sq ft.
- Fuel tank storage and release is pro-

vided. The parachute will not landing roll 600 ft. on field landings.

- Fuel probe extends to fuselage from the right side of the fuselage in the Navy version. Fuel transfer rate is up to 1,700 gal per min.

Extensive studies were begun in 1951 to determine the design parameters for a high performance fighter aircraft. As originally designed, it would be a single-pilot aircraft powered by two engines. It was to be equipped with the AFQ-50 radar and armed with four 20 mm. cannons. It would incorporate 11 external store receptacles for the various ground attack weapons.

Configuration Changes

In the interim, the detail specification was signed in July, 1955, a number of changes were made in the configuration by the Bureau of Aeronautics. Since these changes altered the mission to one which emphasized all-weather capability and air superiority over the attack mission, the design was again changed to the present F4U-1.

At this point the specifications were as follows:

- Two J79GE-8 turbojet engines, producing 30,500 lb. of thrust each and 17,500 lb. with afterburners.
- Sparrow 5 missile armament. Provisions for the 20 mm. cannon were deleted, reflecting improvements in missile technology.
- Improved airborne intercept radar. This is now the Westinghouse APQ-7.
- Simple, lightweight, semi-automatic emergency device.
- Visual ground attack capability.
- Maximum speed of at least Mach 2 with missile armament.
- Two-man crew. An intercept system involving close scrutiny of radar traces were developed, it was determined that the task was too much for one man if he also had to fly the airplane.
- Semi-integrated missile installation.

Until the first flight on May 27, 1958, more than 5.5 million parameters had been expended on the design and construction of the first F4U-1. In the development effort, McDonnell has relied on the services of 1,500 subcontractors and suppliers from 25 states.

At this time, the FAH was in close contact with the Chester Wright F4U-1, an improved version of the F4U-1.

The F4U-1 had a single engine and one crew member.

Although the two aircraft were comparable in performance, the principal factors which led to selection of the FAH were its two-man crew, two engines and ability to reach high speeds without rocket boosters, which was a feature of the F4U-1. In addition, Air Force experience with the McDonnell experimental non-captive F-102 helped by the notes.



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RIGHT: F4U COYOTE

BELOW: SPANISH AIR FORCE

BELOW: REPUBLIC F4U THUNDERBOLT



BELOW: NORTHROP F-5

BELOW: CESSNA 172



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ENGINEER-MANAGERS

KEEP R&D PROGRESS AND COST ON TARGET AT HONEYWELL

Unique approach controls costs and deliveries without inhibiting creativity

Five years ago Honeywell determined that super star R&D management techniques would be unable to cope with the growing complexities of Honeywell's aerospace programs. The myriad of project tasks needed closer management control. Business managers were too far removed from their engineering counterparts to keep tabs on hundreds of daily problems.

The solution? Put business control tasks and responsibility in the hands of the "front line" project engineer—in short, control at the point of occurrence! Honeywell calls it R&D Command Control. The result? Honeywell's expanding Minneapolis aerospace operations:

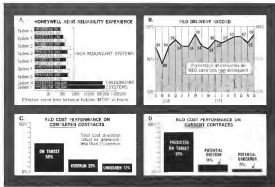
- Reduced engineering schedule rate 11% by the end of last year
- Controlled costs to within 1% of the

net amount quoted on R&D programs over the past two years

- Achieved, or bettered, predicted system reliability on every major aerospace program

- Improved delivery performance—40 times more on R&D contracts was needed to live per cent in 1981.

This indicates that contrary to popular belief, invention can be managed—without impeding creative performance—when engineers are given responsibility for the business management of their projects. And what's more, time and cost schedules are met!



Honeywell R&D performance proves the effectiveness of its Command Control system. Charts show that (A) predicted vs. underscheduled reliability—Honeywell has exceeded or bettered predicted reliability on all major aerospace systems; (B) delivery

performance on R&D contracts at Honeywell Aerospace, Minneapolis. (C) cost performance on completed R&D contracts, and (D) cost performance on current R&D contracts. Note the cost performance improvement between charts (C) and (D).



Honeywell R&D control applied to these major programs

With the awarding of the Apollo-Saturn, Honeywell is now a major contractor on the Apollo, Mercury, Gemini, and X-15 manned space programs.

Honeywell's aerospace experience began with the first of its reference systems for Vanguard. Subsequent assignments include the attitude stabilization and control system for Project Mercury, the 3-axis reference systems for Titan, Agena B, Thor Delta, guidance and control system for Scout, inertial platform for Polaris, inertial guidance for Centaur, flight control systems for Apollo and X-15.

For more information concerning Honeywell's R&D management control techniques contact Honeywell Military Products Group, Minneapolis 5, Minnesota. This advertisement is sold for by Honeywell's, not from government funds.

Honeywell adds unique management techniques to conventional ones

To implement its Command Control concepts, Honeywell uses six management techniques. These are fully contained:

- 1. Program Management.** (ie. Milestone, Line of Balance or PERT)
- 2. Reliability Engineering.** (ie. staff operation, with specialists assigned directly to projects at their outposts)
- 3. Value Engineering.** (ie. combined educational operational function where specialists guide immediate engineers of selective design cost problems)
- 4. Design Process.** (ie. a standard quality sequence, not of engineers, but of decisions, communicated in a way that limits the full experience of the organization toward allowing the highest probability of success)

1. Project Responsibility. Each front-line supervisor is held accountable for the success of his specific task—and the total project.

2. Project Cost Record. The front line supervisor receives a running cost breakdown including predicted cost at completion or target within four working days after each milestone. This permits early detection of problems and quick remedial action which assures overall benefits to the project.

3. Design Process. This is a standard quality sequence, not of engineers, but of decisions, communicated in a way that limits the full experience of the organization toward allowing the highest probability of success.

PERT-Cost Tie-In

R&D Command Control at Honeywell is operationally-improvement is essentially unique. One of these improvements is the development of a standard relationship between Honeywell cost control techniques and recognized technical program evaluation techniques like PERT (Program Evaluation and Review Technique). This relationship is unique in that it is the only one that is both simple and effective. It is the only one that is both simple and effective. It is the only one that is both simple and effective.

Application of these developments to Honeywell military and space programs is advancing the state of the art in R&D management and maintaining Honeywell's reputation for leadership in this field.

5 concepts are key to Honeywell R&D Command Control

Simply stated, there are five basic ideas underlie the management system that provides effective R&D control at Honeywell.

Control must be managed. R&D Command Control experience has convinced Honeywell engineers of this.

Control must be at the point of occurrence. The front line supervisor is the best person to manage problems where they occur.

Technical progress and cost control are inseparable. Command Control correlates both cost and

technical decision making at the front line level of operation.

Tasks must be managed in total project terms. Supervisors must be given the total project picture to make decisions consistent with overall program objectives.

Problems must be detected early. Honeywell recognizes the high risks at R&D work and requires that all levels of management, as well as the customer, must know of problems early enough to take corrective action. Only in this way can problems be managed and scheduled progress protected.



DUAL ADAPTIVE autopilot flight control system developed by Sperry Phoenix Co. adjusts autopilot potentiometers to compensate for flight condition changes. Left, welded modules are mounted on control chassis; right, engineer checks a null zero amplifier.

Autopilot Incorporates Dual Stabilization

By Barry Miller

Phoenix, Auto-Adaptive, automatic flight control system, fabricated with high-density welded packaging techniques to permit use of dual stabilization for each flight axis without adding excessive weight and size, is being developed here by the Sperry Phoenix Co.

The system is being prepared for a number of advanced aircraft and aerospace vehicles, including the Aerospace Plane, the TTX booster tactical fighter and the aerospace transport.

Dual design channels give the system a degree of redundancy. Coupled with other improvements in reliability, these are expected to yield a system—mission-critical failure (MTBF) of 1,000 to 1,500 hr, according to Sperry. This compares with 500 to 1,000 hr (at 70% operation) for a conventional automatic flight control system being manufactured by Sperry for a high-performance naval aircraft.

The adaptive feature adjusts autopilot potentiometers to compensate changing flight conditions which advanced vehi-

cles, such as the Aerospace Plane, would experience.

Sperry engineers call this technology an energy balancer adaptive control. It looks at the entire energy spectrum of control system error signals caused by disturbances or nonrandoms to detect the need for adjusting channel gains. It will automatically optimize control action gain, Sperry explains, to reinvest control error to the extent that this is in keeping with vehicle attitudes.

Large high-frequency instabilities to which the system would have to adapt need not be generated, but should these instabilities be present, the system will correct for them. This is done by band-pass filters which, extending over the full aircraft frequency spectrum, recognize energy levels and form algebraic sums to raise and lower gains.

All present, bandwidth versions of the system are being tested here, and conventional dual, as being prepared.

Operating prototypes have been fabricated as a backup of a non-operating system is being assembled.

As a measure of comparison of its

adaptive system with nonadaptive flight control systems, Sperry cites three figures.

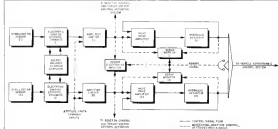
The electronics rack of a conventional system in production for a specific operational, high-performance aircraft weighs 27 lb, employs over 1,000 parts, is packaged into 1,600 cu in. of volume, requires 100 w and will withstand 2g. A manufactured version of this system, employing the high-density, welded modules used in its adaptive system, would shrink it to 11 lb, fewer than 200 parts and a volume of 350 cu in., and cut power to 35 w.

In terms of size, the electronics rack of the adaptive system almost doubles the footprint of the conventional system because of the additional channel for each axis. Thus, there are, for example, six servo amplifiers—two for each axis—rather than the single one per axis in the conventional system.

Consequently, the adaptive system's electronics rack runs about one-third larger in most of its dimensions than the conventional version of the conventional system. At weight about 14 lb, it,



OPERATING BREADBOARD of dual autopilot, left, developed by Victor for Sperry adaptive autopilot and backup of dual packaged autopilot, right. Active points to radius arm which adjusts with nullification in either of two of the two design channels.



BLOCK DIAGRAM of one axis of Sperry Phoenix Co. system shows how dual redundant channels provide stabilization for aerospace vehicle.

occupies 470 cu in., requires about 40 w.

There are other differences between the two systems, so that the adaptive system employs six rate gyro (rather than three), as additional accelerometers and actuators typically designed and developed to accept inputs from dual channels.

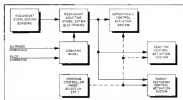
The price of the redundant adaptive system, Sperry says, will run about 10% higher than a standard conventional system. That does not include the costs of the new situation, which are about 50% higher than the cost of a complement of standard situation. Sperry stabilizes the study to hold the price to 10% higher than a conventional system, while adding three design channels and adaptive features, to savings derived from compact construction.

The welded packaging technique used in the adaptive system is one of the simple basics of the packaging approach now becoming more common in space and marine avionics gear (AVR Aug. 24, 1969, p. 104; Oct. 24, 1969, p. 75).

Each circuit module is assembled in a small rectangular box—size of a 100-watt tube which required components are inserted by following "road map" in the structure. When this step is completed, the module modules are encapsulated, leaving component leads protruding from the assembly. Leads are then interconnected and the entire module encapsulated again.

Sperry's own fabrication that was used as other Sperry equipment which has been tested in military evaluation and is going into production.

All of the autopilot electronics, with the exception of calibration units, are contained in 16 different types of the module circuit. Typical circuit in-



CONTROL SYSTEM made a selected by program controller, is shown in simplified block diagram of the adaptive flight control system developed for aerospace vehicle.

clude an amplifier buffer, demodulator, modulator, and state relay, amplifier buffer, and power supply.

Individual modules are mounted into outside faces of small metal structures which are mounted around the equipment rack. Each of the metal structures, which are available in four sizes, can be connected from the rack of modules. This type of assembly permits easy access for maintenance.

Should a complete channel fail, which might represent a critical function such as a servo amplifier, here to be replaced it can be removed from the rack. There are 13 channels in the redundancy system, two adaptive complex, two conventional, two adaptive complex and one conventional.

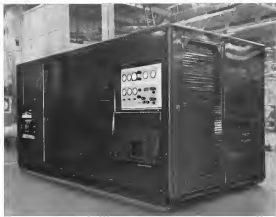
Mod channels receive least to conduct even from the circuit and permit 115°C operation without forced convection. Individual modules are interconnected and have various shaped bases which

mate into holes in the channels to ensure against misalignment errors. Parts design for the adaptive system is about 3,540 parts/in. It, equipped with 1,500 parts/in. in the standard system previously cited.

Welded module packaging, structural protection, better heat sinking and the use of adaptive module circuitry combine to account in large measure for the significant autopilot improvement in MTBF for this system as opposed to its conventional predecessor, according to Sperry engineers.

An MTBF greater than 1,000 hr for the complete control system, and adaptive autopilot actuators, is one objective of the adaptive autopilot development. Other features of the system include:

- **Redundant channels** provide full two stabilization even though individual parts are malfunctioning.
- **Attitude and path computations** are



Automatic temperature control GSE for Titan II missile propellant

This new environment control package was designed and produced by Hamilton Standard for the Air Force's Titan II missile, made by Martin. It automatically stabilizes propellant temperature at $40 \pm 5^\circ\text{F}$ within a 10,000 gallon storage vessel. The unit electrically heats or mechanically cools a glycol and water heat transfer liquid, and then circulates it to the storage vessel heat exchanger. It is built to perform reliably in ambient of -35° to $+115^\circ\text{F}$, and from sea level to 6,000 feet.

The Titan II Propellant Temperature Controller is evidence of Hamilton Standard's ability to meet

environment control GSE assignments. It typifies the results attainable when engineering capabilities in pneumatic, hydraulic, electronic, and packaging, are combined with specialized manufacturing skills.

A NEW BROCHURE describing Hamilton Standard's environment control GSE capabilities for aircraft and missiles is available. To learn how this solid foundation of expertise can be your key to dependable GSE, write: Sales Manager, Ground Support Equipment Department, Hamilton Standard, Windsor Locks, Connecticut.

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COMPARATIVE SIZES of electronic adaptors for three adaptors are shown. Left, production model of system designed for high performance Navy plane; center, miniaturized version of same system using solid modules; right, adaptive system which also uses solid modules in order to reduce the size and weight.

scented from the redundant dampers.

• **Light failure** are indicated on control panel to alert the pilot.

• **End-of-run** (end-of-run) switch indicates ready status of the system. This switch is manual self test for the gas gyro. Normally, a gas test might be a no-go operation, and for the wheel and motor to check ground resistance and position.

In the case of small electronic adaptors facing the spinning surface of the wheel come only, controls to be generated on the wheel of a spinning wheel, in fact, some motion input to keep the output true.

A signal generated in the gyro will pass through the stabilization channel and permit checkout of actuator response.

Dual Channels

Dual operation of two channels for a typical case can be illustrated by reference to the block diagram on p. 54. If the two channels are functioning properly, and therefore have equal gain, the roller arm on the actuator does not tilt.

If the two are not equal, the arm bends giving an indication of failure.

When this happens, one channel automatically inhibits the other by opening whether either servo loop is in proper with respect to input command. If either loop is improper, it will shut off the improper loop and control that end of the actuator.

Gas signals of the channel with the malfunctioning loop will be fed into the proper functioning loop and the gas output.

If the arm rotates due to a failure in a gyro or subsequent circuit, the motion again fed back the servo loop and feed back functioning properly. Thus, the output of the gas network would be cross-checked so that each is fed to both servos. If the failure is due to a

zero output from one gyro, the output from the second now would be feeding both servos, so that system performance is restored.

If the gyro failure is not the master blade zero signal circuit, a process which Sperry calls a "test of master blade" is involved. If the signal is correctly large with respect to the other, a hand-over mechanism is provided to prevent, and test gyro is removed from its channel.

It takes the system 1 sec to detect and re-center the rocking arm for a hand-over failure.

The system does not account for the actual condition of a large gyro signal from one channel and a given failure in the other.

A dual actuator suitable for the adaptive system was designed by Victor Division of Sperry Rand Corp., El Segundo, Calif. In vision requirements had done by Sperry Phoenix. An operating handover of the actuator with external plumbing is shown in an accompanying photograph on p. 54 along with a mockup of the final packaged actuator.

Other Features

Sperry is interested for proprietary reasons to discuss details of the adaptive features of its system. It says other features of the energy balance adaptive control include:

• **Gain adjustment** is insensitive to level of disturbance and is insensitive to level of the vehicle.

• **Internal feedback** norm does speed of adaptation and change energy balance criteria in a function of vehicle conditions.

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The more you specify proof and dust tight, or close fitting, hermetic, heavy black finished stainless steeling leads are used to turn the standard steel shell supporting the rotating brushes.

RESISTANCE BULB SWITCHES

A comparison line of the same construction except that they are fitted with a common terminal ring for thermocouple connection.

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Let's say that you're responsible for the design of an airborne computer which will use micro-miniature components. By contacting an Amphenol Connector Division Sales Engineer, you can now expect these services:

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your production facilities. He will supply prototype Intercon layouts and contract to work with you through test and final approval.

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This is the difference: Intercon's 3.0 inch wide, modular, non-weldable assembly is built in multi-layer modules. Close by the board, making interconnects close to the board, making interconnects close to the board, making interconnects close to the board.

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FILTER CENTER

► **Moore-Renue Used for Stop-to-Start**
—Now has successfully used the Moore as a passive interconnection vehicle to transmit and receive 60 words per second messages between its remote terminal near Washington and the USS Chulavita in the South Atlantic. USS Chulavita is equipped with a 1-in. transceiver and 16th antenna, ground terminal at Sharp Neck, Md., and 10-in. transceiver, 60 ft. dish.

► **Sperry Demonstrates Laser Doppler**
Using a heterodyne continuous wave gas laser, Sperry Corporation engineers have successfully demonstrated the feasibility of a Doppler radar operating at optical frequencies, the computer reports. The laser radar equipment used a movable mirror in the target. Operating at optical frequencies should permit Doppler measurements equivalent to a velocity in as low as one-thousandth of an inch per sec. Sperry says.

► **RCA Adds Doppler to AN/FPS-16**
The FPS-16 monowave radar, widely used as a precision tracker by Air Force and National Aeronautics and Space Administration, can be modified to determine target velocity to an accuracy of 0.1 ft. per sec. using Doppler shift measurement techniques, according to Radio Corp. of America. This new technique was developed by RCA, which builds the FPS-16, under sponsorship of Army Signal Research and Development Laboratory.

► **Rough-Landed Lunar Transponder**
—Eighty-eight transponder, not exceeding 10 lb., and sufficiently rugged to survive rough landing, as the lunar surface, will be developed by General Dynamics/Astronautics for USAF's Electronic Systems Division.

► **Long-Range Secure Communications**
—Long-range secure communications for the Army's future battleship will be delivered to the Army at Ft. Belvoir late this year by Colson Corp. Colson, Fort Collins, or Colson, the system will use a special modulation technique to permit the observer to detect a signal with a high degree of security. Basically, this uses range and range difference techniques to pinpoint the observer. Two radio stations separated by a known distance in friendly territory have to increase range to an aircraft above the battle line, then the position of the observer, identified by signal strength, can be computed by the Army's Field Army Data Acquisition Computer.



GENERAL CONTROLS CORPORATION

LOOKING FORWARD

by John Harte

DEARTE, CALIFORNIA. Sometime next year, if all goes well, the world will witness a new milestone in the field of spaceflight. It will be the first time that a manned spacecraft will orbit Germany—not to the east coast of the nation's constitution but to NASA's Project Gemini, the two-man spacecraft.

Right now, as you read this column, NASA, flushed with the success of Project Mercury, is stepping up for the final go-ahead march of design and development, and testing of the Gemini program. Simultaneously, secret activities concerning selection of the Gemini crew.

One thing is sure: sometime after these silver-shafted men accurately have safely orbited over the overcast Florida, the tension felt by thousands of astonished spectators will slacken.

Ironically, a host of questions have at Gemini's efforts will not be said. There was the task of producing a complete package called the "Machinist's and the Designer's" for the Gemini Co. head of the cancelled Air Force. The Gemini which will be used as the launch vehicle.

When the Gemini vehicle lifts off, there will be several kinds of tests to be performed. It is these tests that are expected to be the most difficult. The Gemini will be used as the launch vehicle.

The multi-stage system is typical of many safety measures that are built into the Gemini spacecraft or booster. They are solutions to the value that set in a solution phase upon the first of these two men, the mission will be before them, and is, in fact, all human life. The only is a series of tests and training for themselves.

Each would be the economy of the last three likely to be in form for error in the equipment.

As Ed Brown, Air Chief Engineer of General Controls' Gemini Division says, "The design, like the construction, must be 'twice'."

"Redundancy—a second part of operation of the first line—is the rule. Even if the first line goes out of the system, there are two. These systems are emergency switches."

"The system also has duplicate wiring—instead of three power leads on each gyro there are six, instead of two on each gyro, there are two."

This is not simply a case of safety in numbers, redundancy has not been substituted for effective design.

A graduate electrical engineer, Brown is a gyro specialist whose pastured life was shaped in the solid foundation of a job spanning single-minded Dr. Deper

at Massachusetts Institute of Technology. One of the projects in which Brown was involved was the development of a guided weapons (GWS) gyro. For more than a dozen years now, he has been working exclusively on gyro, and during that time he has been credited with numerous successful design innovations, including his own design of what he describes as "the world's one true gyro."

As if the role of design of the "Guidance Gyro Detection System" were not enough, Brown then goes on to describe its self-test features which insure even greater safety.

"Each gyro has its own speed monitor, which reports whether or not the gyro is spinning at the required rate of 34,000 rpm. After that, it is a guided weapons gyro. With this, by closing a relay, you can immediately or automatically turn the gyro to set it in a spin, or stop it. The gyro or set it in a spin, or stop it."

This package has been designed a critical area by the Air Force Space Systems Division. This Gemini Controls engineers had to make carefully the design of the critical parts in the package, as well to subject the individual components to rigorous testing.

The project has been a high priority program. The project was ordered last January by the Air Force and has been assigned to the Air Force Space Systems Division. It is one of the most important projects in the Air Force Space Systems Division.

General Controls, though they are the first system to be used in the Gemini spacecraft, is a sub-contractor of the Gemini spacecraft. It is a sub-contractor of the Gemini spacecraft. It is a sub-contractor of the Gemini spacecraft.

Because closely after the test, the Gemini spacecraft is the member of 1969, we shall witness another successful record of a guided weapons gyro.

For the opportunity to design even more demanding systems for projects beyond Gemini—for the men to follow—General Controls' Brown and Caperton—there are many engineers who are working at General Controls who are equally... Looking Forward.

General Controls Corporation

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THE BIG PICTURE

at Lockheed Missiles & Space Company

The urgency of today's major weapon and space projects has given rise to a new science of management. Its basic premise: In order to meet an absolute deadline, manufacturing must get underway while research, engineering, and testing are still going on. This management philosophy has been employed with notable success at LMSC on critical Air Force, Navy, and NASA programs.

Complex projects are masterfully preplanned by LMSC management. Project schedules can be shortened by starting several phases of a program at the same time without all its experience.



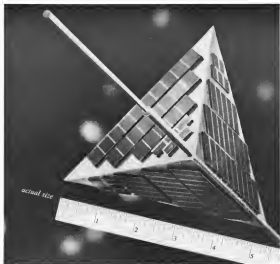
Lockheed project planners (above) can accurately predict the cost of future weapons and space systems, both in dollars and in elapsed time, by applying these new management techniques.

New management methods compare paperwork. Beforehand (left photo) (right) shows how number of reports required from a typical subassembly section in one 10-month period were reduced.



Each phase of major programs requires research problems to be solved on schedule. Typical of the scores of R&D projects at LMSC are the growing use of high temperature Super Alloy materials such as Inconel and pyrolytic graphite (above) and shortening a missile by directing its rocket exhaust with a fluid injection of cold gas (left).

Lockheed Missiles & Space Company, Sunnyvale, California
is a group division of Lockheed Aircraft Corporation.



The world's smallest satellite has been developed by Space Technology Laboratories. Its shape will be different from all other satellites before it. STL engineers and scientists have used a tetrahedral configuration to bring about some remarkable characteristics in a space vehicle. There will be no need for batteries nor regulators in flight. The satellite will have no heat sink, no cold sink, it will require no attitude control devices. No matter how it tumbles in space it will always turn one side toward the sun to absorb energy, and three sides away from the sun to cool instrumentation and telemetry equipment inside. It can perform related experiments in conjunction with other projects. Or it can be put into orbit by a small rocket to make studies of its own, up to five or more separate experiments on each mission it makes.

STL is active on hardware projects such as this and as prime contractor for NASA's DGO and an extremely new series of classified spacecraft for Air Force — ARPA. We continue Systems Management for the Air Force's Atlas, Titan, and Minuteman programs. These activities create immediate opportunities in: Space Physics, Radar Systems, Applied Mechanics, Space Communication, Aerospace and Micro-wave, Analog Computers, Composite Design, Digital Computers, Guidance and Navigation, Electrooptical Devices, Engineering Mechanics, Propulsion Systems, Materials Research. For So. California or Cape Canaveral opportunities, please write Dr. R. C. Porter, Dept. A, One Space Park, Redlands Beach, California, or P. O. Box 4277, Patrick AFB, Florida. STL is an equal opportunity employer.



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SPACE TECHNOLOGY

Sublimating Ablative Compounds Tested

New York—New approach to thermal control systems developed by Emerson Electric Mfg. Co. uses specially formulated sublimating compounds for three-point control of structural temperatures beneath the compounds.

The use of sublimation techniques for temperature control is not new, some cooling ablative materials are sublimation. But the Emerson contribution to this complex technology is a series of developed compounds that sublimate at fixed and consistent temperatures. This permits the designer to select a temperature limit for structure or equipment below the heat shield material with confidence that the limit will not be exceeded.

Currently available material, which is called Thermo-lag, is designed for a range of sublimation temperatures between 2100° and 2200°.

The compounds have been tested in laboratories, under simulated on-orbit conditions using plasma arc jets, and on actual rocket propelled vehicles. Current applications include heat shields around the Saturn first-stage nozzles, Scout Plus rocket motor nozzles, Warden, Tard Missile, Apollo and Javelin nose cones, and Scout vehicles. Results of the flight tests have confirmed the theory of Thermo-lag operation, Emerson says. Sublimation is a fundamental physical process in which a solid changes to a gas without going through the usual liquid phase between. Chemical example of this is solidified carbon dioxide ("dry ice") which goes through a phase change from solid directly to gasses.

The process is endothermic, it absorbs heat during the phase change. Any process that absorbs heat suggests application to cooling systems or to thermal protection systems.

The development of thermal control systems for ballistic missile vehicles has shown one route for the evolution of such systems. Starting with a heat sink, which was usually enough available to absorb the amount of heating without melting or vaporizing, the two point-control system evolved to absorb the excess heat by sublimation.

Ablative works by a combination of chemical reactions, such as decomposition, and heat transfer to protect the solid material underneath the ablating layer. It is most successful when the heat flux is high and when the heat pulse—the rate of application of the heat flux—is short. Maximum long-term heat fluxes are not limited by heat flux but by ablative materials.

Emerson's argument, stated by Robert Feldman, chief of the company's Thermodynamics-Chemistry Division, is that ablative materials require additional insulation to protect the structure or equipment underneath. This is because the ablation temperatures vary directly with rate of the heat input, the higher the heat flux, the higher the ablation temperature.

Thermal conductivity also runs with pressure at temperature, so that the heat temperature caused by the surface under the ablative layer increases with time as ablation occurs. This says Feldman is what creates the need for additional insulation under the ablation layer.

Thermo-lag compounds are inorganic, and some of them—which sublimate at relatively low temperatures—release materials to produce a debris layer.

This debris performs four useful functions to enhance the heat shield capability of the base material. It insulates against heat by virtue of its physical properties; it radiates heat leaving its outer layer at a higher temperature than the virgin material below it; it provides an area of increased temperature where the ablating gas can disperse more easily and three-fourths more heat, and it provides a region for hypersonic cooling by passage of the ablating gas through the porous debris layer.

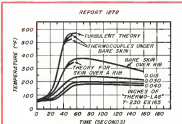
These four instruments of cooling, added to the base process of sublimation,

provide a total thermal control system with a predetermined temperature level. Feldman says any vehicle using Thermo-lag as a protective system can show appreciable weight savings over one protected with organic ablative materials because the plate thickness can be decreased only by structural requirements and not by the need to have also an insulation.

The company points out that Thermo-lag compounds can be designed to a such "medium measurable limits" a desired rate of sublimation and thermal properties. Thermo-lag can be painted on with spray, brush or dip techniques, molded to shape, or applied with a brush. It can be impregnated or laminated with other materials. Once it is formed, it can be machined to a final contour so that any excess of material can be removed.

Exposure of the compounds varies from one type to the other, with typical values of 90, 90 and 100 Btu/sq. ft. Thermal conductivity approximates 0.5 Btu-hr/ft-sq. ft. The materials are essentially transparent to radio frequencies in the X-band region.

One of the lower temperature Thermo-lag materials—T-215, which indicates that it sublimes at 2150°—was tested on NASA Scout vehicles. The material was tested in three thicknesses—.0115 in., .036 in. and .0415 in.—on the fin of the second and third Scout vehicles and on a portion of the heat shield on Scout 3. Telemetered tem-



TELEMETERED DATA shows Thermo-lag performance on fin of Scout 3 vehicle



KAMAN LOOKS TO FOOTE BROS. FOR TOTAL CAPABILITY IN HU2K-1 TRANSMISSIONS

When Kaman Aircraft Corporation's high speed, long-range HU2K-1 utility helicopter was in the design stage, Foote Bros. was chosen to build the main rotor, intermediate, and tail rotor transmissions. In choosing Foote Bros., Kaman knew a real asset on the experience, skill and facilities that have earned the aero/space industry for more than two decades. The performance of Kaman's transmission have gained Kaman's confidence.



Main Rotor Trans.
shown is one of
three Foote Bros.
transmissions in
the HU2K-1 utility
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Foote Bros. offers coordinated facilities in these areas:

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POWER TRANSMISSION DRIVES



Thermionic Converter

New 100-watt thermionic converter consisting of five anodes closely clustered in series, is mounted in support so that both sets of anodes form a vacuum cavity. Self-heating occurs from cathode input. Converter was developed by Thermo Electric Engineering for Thompson Ramo Wooldridge which is building solar-thermionic engines for USAF's Aeronautical Systems Division.

positive batteries showed the material to perform in accordance with its predicted properties.

Other tests under more extreme temperature conditions were made at the University of Chicago's Madam Laboratory, using a plasma jet from an air-stabilized electric arc heater. The material survived at 1,500° Fahrenheit at 100° Fahrenheit temperature was increased for a large number of rotations which included stagnation temperatures as high as 17,740° with a corresponding stagnation velocity of 20,930 ft/s (7).

Internal temperature measured with thermocouples showed well below the 500° Fahrenheit. In some cases where the stagnation temperature was 10,500° Fahrenheit, the internal temperature reached only 150° Fahrenheit after 90 sec. of exposure to the plasma.

Thermocouples are a positive material and has recently been allowed 10 percent classes related to its performance.

Goldwater Urges Plan For Military in Space

Washington—Sen. Barry Goldwater (R-Ariz.) said recently the time has come to enlarge the military role in space, declaring "the armed forces should already be planning the development as soon as possible of a completely integrated space warfare system."

Sen. Goldwater, a leader general in the Air Force Reserve, said "space is

a medium for three-dimensional mobility for good or evil. So in extending our military space capabilities the U.S. would do well to make absolutely certain that we will never be surpassed technologically in space."

He said it was disturbing that so many policy statements indicate the bulk of U.S. space activity is under the National Aeronautics and Space Administration. "I do not think this is so," Sen. Goldwater said, "and I do not think we should say it is so." He said the military responsibility should be specified and it is a new national policy statement in space (ENR June 16, p. 20).

"The tank has come," Sen. Goldwater said, "to put more trust in the lessons of history which teach us that every broad new field of technology produces a wealth of military applications." Our armed forces need personnel and prepare to conduct military space missions in depth as these can be recognized and defined."

He said it appears at present that the Pentagon is not sure where to turn but it is going in the direction of a military space program. He said the potential exploration of space cannot be ignored unless the U.S. also provides itself with the necessary military capability in space.



Delavan's 152 small gas turbine

A PRODUCT OF DELAVAN EXPERIENCE

The Lycoming 152 small gas turbine engine is currently in use on helicopters, observation aircraft and in Marine and industrial applications. It is the fuel injection nozzle developed by Delavan for the 152.

If one word were chosen to sum up the reason for Delavan's success as this fuel nozzle program, that word would have to be experience. Experience in designing highly functional, reliable fuel delivery and metering devices, ex-

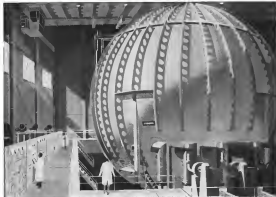
perience in large scale manufacturing of the intricate and precise parts that make up a fuel nozzle, and experience in controlling the quality and performance of these devices on a mass scale.

Add this experience to Delavan's willingness to react quickly to the urgent needs of a dynamic industry and the results are always the same... excellent quality, a good delivery record, and measurable price. Be sure Delavan is a part of your engine program.



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Manufacturing Company

WEST DES MOINES, IOWA



For General Electric's Valley Forge Space Technology Center, Stokes designed and is currently installing three space simulation chambers that duplicate the one shown above in the center sketch. The chambers, 36 ft in diameter, will be continuously purged to achieve high vacuum, and will produce a severely acidic or basic atmosphere by gas diffusion making highly efficient gas loads.

EXPERIENCE IS WHAT COUNTS IN SPACE SIMULATION

While space simulation is a new and rapidly changing art, experience in designing and building equipment for its full-scale accomplishment is of the utmost importance. That is because manufacturers, as applicants have no doubt, reliability proving depends on accelerating absolute values.

F. J. Stokes often is an impressive backlog of experience in supplying major space test facilities. The installations described above and others for General Electric, the various test and engine systems for facilities at NASA's Goddard Space Flight Center, the test chamber for Bell Telephone Laboratories' Teletest project, reliability testing facilities for spaceborne electronic components, and pumping systems for various aerospace research centers stand as testimonials to Stokes' progress in this specialized area.

But of this specific activity stands half a century's experience as one of the world's leading manufacturers of high-vacuum industrial systems. Since vacuum is the constant denominator of all space test equipment, it follows that Stokes' high-vacuum experience, unique engineering capabilities in this field, and extensive, long-standing fabrication facilities can be successfully applied to problems of space simulation.

If you are engaged in any phase of space test work, we will gladly explore the possibilities of putting Stokes space simulation and high-vacuum experience to work for you, on a project management, single-source, turnkey, or any other basis. Space Systems Department, F. J. Stokes Corporation, Philadelphia 20, Pa.

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STOKES

NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

RESEARCH AGREEMENT, MANHATTAN
Rural Data, South Africa. \$40,000 for the research on water-soluble solid or particulate matter dose levels for use, evaluation and development in environmental and life development.

Space Technology Laboratory, Inc.
Florida Beach. \$200,000 for the development and experimental studies of variable velocity rockets.

General Mills Inc. Minneapolis. \$100,000 for the research in dynamic behavior and stability of stable orbital structures in space.

Rural Water Co. Arroyo Grande. \$200,000 for the experimental studies for development of water in space.

Applied Analysis Corp. Philadelphia. \$100,000 for the research on the development of optical and infrared sensors for the detection of objects in space.

General Electric Co. Philadelphia. \$100,000 for the research on the development of optical sensors for the detection of objects in space.

American Universities Satellite Project. \$100,000 for the development and installation of satellite systems for space research.

Los Alamos National Laboratory. \$100,000 for the research on the development of optical sensors for the detection of objects in space.

General Electric Co. Philadelphia. \$100,000 for the research on the development of optical sensors for the detection of objects in space.

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OAO Star Tracker

Star tracker, one of the most important instruments in the OAO (Orbiting Astronomical Observatory) program, is now in production at Lockheed Instruments. The instrument will be assembled in space so that it can be used to track the position of stars and other celestial objects. The instrument will be used to track the position of stars and other celestial objects.

Lockheed Instruments, Sunnyvale, Calif. 94089. For more information, contact Mr. J. R. Smith, Director of Sales and Marketing.

General Electric Co., Philadelphia. \$100,000 for the research on the development of optical sensors for the detection of objects in space.

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PROBLEMATIC RECREATIONS 129



Prove that the product of a consecutive positive integers cannot be a perfect square.

—Covard

Proving the result's truth can be done in a few minutes. The result is the product of a consecutive positive integers. The result is the product of a consecutive positive integers. The result is the product of a consecutive positive integers.

ANSWER TO LAST WEEK'S PROBLEM: 37 dollars. If the total weight amounts to 60 pounds, then the grocer from whom I did not purchase a packet gives short weight. If the total weight is 59 1/2 pounds, then the grocer from whom I purchased one packet gives short weight, etc.

LITTON INDUSTRIES, INC.
Beverly Hills, California



HOW DO YOU KEEP THE PEACE WHEN EVERYONE HAS A KEY? This is the challenge given Bendix by the United States Arms Control and Disarmament Agency in its first contract to industry. Our assignment is to study on-site and remote techniques to monitor declared arms production and to detect clandestine production of strategic weapons such as long-range missiles and bombers. Such techniques could be implemented by an inspectorate established pursuant to an arms control or disarmament agreement. Scientists with experience and knowledge of international economy, industry, transportation or political science as well as operations analysts interested in joining this expanding area, write or call Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division



MANAGEMENT

Industry Welcomes Depreciation Policy

Washington—Aerospace manufacturers are welcoming the Administration's new program for accelerated depreciation write-offs as a long-awaited initial step, but believe it will have such a mild effect on spacing plant and equipment expenditures in the industry.

The impact is expected to vary noticeably from company to company.

Airline executives expect little, if any, effect on their industry. But in principle, they applaud the Administration's move offering tax incentives for quicker replacement.

The new program (AW July 16, p. 38), effective as of July 13, establishes an eight-year norm for the equipment life of aerospace manufacturers. The total cost of equipment can be deducted as for returns within eight years.

A firm can claim this same-effort question by Internal Revenue Service for a period of three years. At the end of the three-year period, IRS will determine if another provision of the new program has been claimed; the company must also have an eight-year replacement cycle.

In the past, IRS has established varying lifetimes for different types of equipment, based on estimated historical performance. These varied not only between types of equipment but from company to company, for the same general type of equipment. Treasury Department says the industry's depreciation spans has averaged out at 10 years.

There is no comparison in effect to the new eight-year norm. Aerospace industries have anticipated that companies that already have contributed greater depreciation space with IRS will continue to do so. AIA also noted that some companies, unable at the end of three years to deduct the replacement for an eight-year replacement cycle, may want to continue the longer depreciation space they have established with IRS.

For airlines, the new program will act to offset the possible depreciation deduction in an average 1976 year, as pointed out by Treasury Department, while possible a \$20 million a year saving in taxes for the air industry.

Airline executives apparently agree that the initiative is not in a financial position to take advantage of this possible saving. It would mean that at the end of the three-year period, they would have to be on a six-year cycle of aircraft and aircraft equipment replacement—six years out for the airlines under the new program. The depreciation spans for new jets now runs up to 12 years.

Airlines in a poor earning position are



Hiller Camel Mockup Assembled

Mockup of Hiller Aircraft Corp.'s Camel helicopter assembly helicopter, known concept package which can be disassembled or stored on small truck. Two-ton crane begins assembly which can take as little as 12 min. In folding out onto blades. Tail boom is then attached and used as lever with folded-down cargo platform to deliver to pick up some section. Landing disk is folded down and locked in place. Cockpit canopy and air panel are attached and helicopter is ready for flight. Powered by 100 hp. PTO Fiat 4. Whetstone gas turbine, Camel comes in standard equipped troops or a 1,000 lb. payload. Range is 180 mi. and out of about 180 ft. Developed in a company project, Camel flying model is currently undergoing evaluations in the Army.

A NEW KIND OF DATA PROCESSING SERVICE



(Or: How to profit from computers without having one)

You don't have to forgo the considerable advantages of electronic data processing simply because your machine or computer needs don't justify the high costs of a computer on the premises and a skilled staff to run your payroll. Build Systems computer service can deliver profitable results of reasonable cost.

The idea of a systems computer service is new. It's the logical result of the need to apply today's amazingly diverse data processing devices to a kaleidoscope variety of commercial, industrial and engineering problems.

What is new... from Build... is versatile, mid-range computer service that is complete in every way, from initial analysis of the problem, through programming and processing, to interpretation of the results.

Build Systems service reflects the fact that you come to a data processing bureau for one basic, overriding reason... to get the solution to a problem... a solution that will save you time or money or both... and to get it faster and more dependably than by any other means.

We provide whatever it takes to get that solution. If your computer program is set up, we'll handle the actual processing for you. If not, we'll develop it for you—and that includes determining the optimum program. If you require special input/output or control devices, we'll design and build them. If your problem isn't clearly defined, we'll pro-

vide systems analysis to pinpoint, analyze and code it. You may not even know exactly where the problem lies. We'll find it.

Not even complete service stops when the data has been processed. Build Systems offers experienced consultant management experience to help you run your business, physical and financial resources to best advantage as a result of your data processing program.

The members of our Systems service represent a diverse array of professionals... from statistics, mathematics and computer technology to business administration. They apply equally diverse techniques—linear programming, multiple regression analysis, critical path scheduling, mathematical model building and a host of others, kept up to date by constant operations research. And Systems is backed by over 50 years of Build experience in developing and manufacturing specialized data handling and display systems.

If you have a problem you've set aside for lack of computer equipment or manpower... or one that has related solution... we can generate you some engineering ideas and down-the-road recommendations.* Write to Systems, 131 Hill Lane, Mount Laurel, N. J.

*We can also deal with other business problems—often take into the machine ourselves, but only if the machine is available. We'll even the computer while yours is down by the hour or day depending on how long your machine is down.

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also expected to be included to keep tax benefits in order to allow a more favorable public presentation.

For example, if a company with a gross income of \$100,000 deducts \$25,000 for depreciation and \$50,000 for other expenses, it shows a net income before taxes of \$50,000 and a net income after taxes of \$25,000. If the company were to deduct \$50,000 for depreciation, it would show a net income before taxes of only \$50,000 and a net income after taxes of only \$25,000.

F. L. Frazee, vice president and treasurer of Lockheed Aircraft Corp., or proposed general accounting industry regulations to the new depreciation program.

"It is generally a step in the right direction. It is primarily important because it acknowledges at long last that depreciation practices have been largely inadequate—giving no consideration to the increasing cost of equipment or to technological advances requiring new equipment."

Frazee said that further incentives for equipment replacement in the aerospace industry are urgently needed—although these appear to be no general practice. He said that in the past Lockheed and other companies had been forced to incur an expenditure without the new tax benefits to meet competitive and military requirements.

The Administration also looks on the new depreciation program as a first step in developing industrial modernization to accelerate the country's economic growth and to meet foreign competition.

The next step in the Administration's program is a 7% tax credit for investment outlays. This has been approved by the House and the Senate Finance Committee. It is included in the Administration's overall tax revision bill. Enactment of the measure in an accelerated fashion is also controversial.

In announcing the accelerated depreciation program, Secretary of the Treasury, Douglas Dillon, observed that "it subjects an administrative policy devoted to a continuing review and updating of depreciation standards and procedures to long absent of changing conditions and circumstances." Dillon acknowledged that "new depreciation standards have not been revised for a great many years. Based essentially on taxpayer self-appraisal practices, they have inadequately reflected the increasing pace of economic and technological change."

Even with this new depreciation program, Dillon reported, the tax incentives for U. S. firms to invest will be "the least of equities" with the incentives offered Japan and European governments. He emphasized that the additional 7% credit is needed to place U. S. firms in a favorable position.

GAO Urges Tighter Engine Supply Control

Washington—General Accounting Office has recommended that the Defense Department establish a control office to manage the supply of aircraft engines to avoid the type of waste it says it uncovered in counting Air Force and Navy procurement of spare parts.

A GAO report filed with Congress and the Air Force and Navy spent \$2 million for aircraft engine parts which could have been obtained by disassembling excess engine already on hand. Nearly \$4 million still could be saved if the two services canceled plans for additional orders and took the parts from inventory.

Paul H. Riles, deputy assistant secretary of defense for supply and services, told GAO that Defense would try to search the inventories cited by the agency and also would strive for "uniform controls and procedures to ensure optimum inter-service utilization of available assets."

GAO's review of spare part procurement was made between Dec. 1, 1960, and Aug. 1, 1961. The agency, in trying one instance of waste, and the Air Force and Navy from January, 1958 to February, 1961, spent \$1,760,000 for parts which could have been obtained by disassembling excess Air Force F-15A-D engines held by the Navy. Other waste stemmed from multiple lack of coordination between the Air Force and Navy, GAO said.

PRODUCTION BRIEFING

Boeing Co.'s Vertol Division, Meriden, Pa., has received a \$1,718,757 Air Force contract to engineer a test program aimed at extending the time between overhauls of its turbine compressor on its HC-130 Hercules helicopter, built and purchased in the Army through the Air Force's Aeronautical Services Division.

Aviation Trades, Ltd., London has sold two Canby ATE-45 engine/generator from Lockheed Aircraft of Los Angeles. The engines, Douglas DC-4 conversion (AWAP Aug. 5, p. 45), are the first sold outside of Great Britain. They are freight and installation and will be used in the Comptech Repaire at United Nations, said.

Northrup Corp.'s Vertol, Calif., Division has received a \$5,475,450 Army contract to continue responsibility for air branch, flight control and tracking, and maintenance and repair of RF-75 rocket-powered targets next

FOR TIME FOUR

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ON ONE COMPACT CHASSIS
WITH EECO 811
TIME CODE GENERATOR



EECO 811 1800 FORMATS

| Time Code Format | A | B | C | D |
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A recent example is the Fruehauf engineered

platform and underconstruction for the portable rock crusher manufactured by Eagle Crusher Company for the U.S. Army Engineer Corps. This amazing plant on wheels helps the military literally make its own way—anywhere. It produces a complete range of aggregates from natural deposits for use in concrete, blacktop and asphalt mixes for the construction of roads, airfields and missile bases throughout the free world.

For further information on Fruehauf's broad versatility as a designer and producer of equipment for the military, send for your free copy of "Fruehauf G.S.E.—Military and Missile."

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by Army Air Defense Command) in positive firing of Nike Ajax and Heron missiles at McClellan Range, Ft. Bliss, Tex.

General Dynamics Corp.'s Parsons Division has received a \$21,202,345 Army contract to continue research and development of the Mako anti-air defense missile.

Aero Corp., Woburn, Mass., has received a \$505,637 National Aeronautics and Space Administration contract for further development of an advanced design 50-lb-thrust jet engine for use on deep space probes.

A. M. Kasey, Inc., Cincinnati, Ohio, under \$111,000 contract, will design a high-pressure water system for cooling the Saturn C-5 static test stand now under construction at National Aeronautics and Space Administration's Marshall Space Flight Center.

General Dynamics Corp. has received a \$104,000 National Aeronautics and Space Administration contract to expand its study on the effects of reentry reduction and cryogenic temperatures on materials to be used in modern powered space vehicles.

Mission H. Cowell and Associates, Inc., Miami, Fla., has been awarded a \$100,000 contract to design a dynamic test tower for the Saturn C-5 launch vehicle at National Aeronautics and Space Administration's Marshall Space Flight Center.

Quanta Industries' Polymer Division, San Carlos, Calif., has received a \$200,000 contract from Thermo Chemical Corp. for production of standardized side-arm quartz microbalances for cryogenic use on all three stages of the Shenzhou rocket.

Syston-Dunham Corp., Concord, Calif., has been awarded a \$142,800 contract by Thermo Chemical Corp. to build an automatic data system to be used in the environmental test program of the first stage of Air Force's Minuteman ICBM at Thermo's Hughes Cos., Utah, test facility.

Electronic Associates, Inc., Long Beach, N. J., has been awarded a \$475,000 Air Force contract to build an analog computer system which will be used to train X-20 (Shenzhou) crew pilots at Edwards AFB.

H. I. Eskew and Sons, Birmingham, Ala., will construct a support building under a \$47,308 contract for National Aeronautics and Space Administration's C-5 dynamic test facilities at the Marshall Space Flight Center.

ACTION MEMO
FROM: Design Engineering

TO: J.M.H.

Dep't 41-A

I understand Cherry can support all the claims they make in this ad. so, we should be using the Cherrylock Jet, get an evaluation going immediately
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SHIMMERING-GRAZ-PAULER M222: Flaunts third prototype, in foreground, shows extent to second prototype in rear.

Austrians Aim for German Twin Market

By Edith Wallard

Vienna—Stearman-Graz-Pauler: A G (SGP) is going into series production as its fourth variant of the two-engine low-passenger M222. Flawless first production model of the aircraft is now scheduled to begin flight tests.

Designed primarily for the business and sport flying market, the production model was evolved through the previous manufacturer and flight test of three prototype versions. Confident that its final design will be granted Federal Aviation Agency certification, the company plans to build a first production series of 25 to 30 aircraft by the end of next spring, although, if required, its workloads could handle twice as many.

Market Foreseen

The company says it expects West Germany to become its best initial European market area. Inquiries for the M222 have been received from potential West German buyers, particularly during and following demonstration of the second and third prototype models at the Hannover air show this spring (AW May 34, p. 54).

Final sales price for the production model of the M222 (Graz-Pauler) has yet to be determined, but the company says it should ultimately work out to between \$12,945 and \$16,821, with full blind flying accommodations as an optional extra.

Like the previous three prototypes, the M222 production version is still basically all composite wood metal plastic construction, but the firm is now

using increasing amounts of steel and polyurethane film skin produced as its own new plastic factory. For example, wings and tail are made of wood, whereas the stretched fuselage has polyurethane film replacing the aluminum alloy covering on the three previous models. The fuselage plastic canopy roof is now steel in its connecting frame for the wing tip struts.

Fuel load has been increased to 100 gal from 55.5 gal, primarily through reduction of a tank in each wing wing section. Tip tanks, however, are slightly smaller than those used on earlier prototypes.

To improve aerodynamic characteristics of the aircraft, the vertical fin has been squared off at the top and an aileron fitting into the fuselage has



FRAMEWORK of the second prototype at the SGP M222 shows combination wood-metal plastic construction. Increasing use is being made of steel and polyurethane film skin in the production version to reinforce the structure. In foreground is an engine test rig.

been eliminated. Horizontal stabilizer has dihedral and the rounded fuselage of earlier prototype variants has been converted to a box construction.

The production version can be powered at the customer's option by either two 150-hp Lycoming O-360-B1A or 170-hp Lycoming O-360-A1A flat in piston engines, although SGP thus far has received only preliminary official approval to install the 200-hp powerplant.

M222 Performance

Maximum speed at sea level with the 200-hp powerplants will be 185 mph as compared with 156 mph for the 170-hp third prototype. Cruise speed with 75% power increases to 144 mph from 128 mph, whereas cruise ceiling of the production version is 10,000 ft, as opposed to 21,000 ft for the third prototype. Landing speed is 65 mph compared with 69.5 mph of the third prototype.

Gross weight on the production model has been increased from 3,840 lb of the third prototype to 4,150 lb, while payload is up from 1,250 lb to 1,450 lb and empty weight from 2,530 lb to 2,750 lb.

Corresponding maximum airframe loads include a 39 ft span from 16 ft and a length of 29 ft from 25.5 ft.

While the third prototype has an overall height of 15.4 ft with landing gear retracted, the production version will stand only 13 ft above the ground.

First prototype M222, powered by two 140-hp Lycoming engines and fitted with variable-pitch propellers made by Germany's Hirthwerk & Co., was developed and built in slightly over one year, flying for the first time in May, 1970. It was lost in August of the same year when it crashed short a corner of flight maneuvers.

Following the subsequent official accident investigation concluded that the crash was not due to any structural weakness, and the company accelerated construction of its second second prototype (AW Nov. 30, 1970, p. 59), which was completed toward the end of 1970.

Third prototype has two 180-hp (1320 X) Lycoming engines and features a 5 built thrusting, counter-rotating propellers as well as a door on either side of the cabin, in place of the sliding plastic roof canopy and variable-pitch flat main propellers of the first two prototypes.

Engine of Stearman-Graz-Pauler's current design at Vienna Neustadt total about 52. The plant has its own airfield plus one 984 ft x 1,512 ft

tarmac, and since a ample room still available for further expansion if needed the company can

Accelerate development and production is, however, a relatively small and recent branch of the firm's activities. Its initial venture began with the development of the first M222 prototype late in the 1950s.

Vienna Offices

Established about 125 years ago, the firm first became known for the main factory and export of locomotives and a wide variety of diesel-powered vehicles. Over the years, cables, cable cars, motor cars, boats, motor boats, cranes and other mechanical devices have been added to its production program.

Head administrative offices are located in Vienna together with three of its five factories, in addition to one in Graz and the Vienna-Neustadt aircraft plant.

SGP's total labor force is about 10,000, but, with the growing air air branches of industry in Austria in recent years, particularly in the building industry, the company's technical director, Karl Zisch, says the general manpower shortage is having its effect on SGP's activities and lack of skilled labor contributes to present a major problem.



WIND TUNNEL MODEL of production version of the Stearman-Graz-Pauler M222. Flawless, first in series, shows changes from prototypes. Company plans to build in metal body of 29 ft, feet of which is due to fly soon.



Second Potez 840 Modified Before U.S. Tour

Second Potez 840 executive turboprop, being refitted for a full demonstration tour in the U.S., is being flown at Tignes with an extended nose housing a Collins weather radar installation as well as providing extra baggage room. A window has been added on each side of the fuselage to comply with Federal Aviation Agency regulations.



Gross weight of the Potez 840 has been increased to 18,700 lb. Auxiliary power unit access panel has been shifted forward and the radio seat for aviation equipment cooling has been installed on the starboard nose section. The 840 will be produced in limited quantities with the first units scheduled to roll out in early 1964 (AWE Feb. 5, p. 69).



INTERNATIONAL AIR TRANSPORTATION ISSUE SEPTEMBER 10, 1962

The impact and challenge of recent trends and developments in international air transportation will be the subject of **AVIATION WEEK & SPACE TECHNOLOGY's** International Air Transportation Issue, September 10, 1962.

This major editorial effort will analyze the direction and problems associated with the growth and expansion of air transportation in all major world markets including Atlantic, Europe, South America, Africa and Asia.

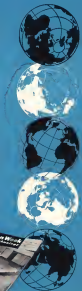
Subjects slated for special emphasis are: Development of a new U.S. international air policy; World-wide impact of common market and African consortiums; New flag carriers of emerging nations; New trends in supersonic transport research; Communist bloc penetration in world air markets; 1962 traffic trends; and future international tariff and merger problems.

Copies of this issue will be airlifted to delegates at the opening session of the International Air Transportation Association (IATA) Conference in Dublin, Ireland. Here will be gathered the international leaders of air transportation whose attention and discussions will be focused on these and other major issues.

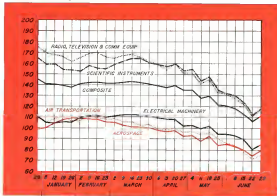
With **AVIATION WEEK's** reputation as the authoritative, respected voice of international aviation, the International Air Transportation Issue will receive world-wide readership and impact.

**Aviation Week
& Space Technology**

A WEEKLY PUBLICATION
320 W. 42nd St., New York 36, N.Y.



FINANCIAL Aerospace Common Stock Performance



Performance of common stocks of aerospace companies and related on the New York Stock Exchange during the first six months of 1962 shows that both groups had begun a gradual slide two months before the major market break in May. The chart is based on the Securities and Exchange Commission's index of weekly closing prices of stocks on the exchange, and 1957-58 stock averages are equivalent to 100. Aerospace industry stocks are compared with those of companies in the electrical machinery, communications and instruments fields—which includes companies with business in the defense area and in commercial fields as well—and with the average for all stocks. Decline in the communications and instruments groups including many of the so-called "blue-chip" or growth stocks, whose prices rose sharply since the time of paper profits rather than current business showed a relatively proper decline.

New Offerings

The Fushion Co., Fushion, Mass., engaged in the manufacture of industrial instruments for measuring, recording and controlling temperature, position, flow, humidity, liquid level and other process variables. Offering of \$2,204,000 for convertible subordinated debentures, due 1967, for subscription by various stockholders at the rate of \$160 of debentures for each 78 shares held. Of the proceeds, \$1,080,000 will be used to construct and equip a new research and development building at Fushion, \$400,000 to construct new facilities for manufacturing, testing and sales support for products at Lincoln, Boston, \$540,000 to expand the plant facilities of the company's British and Dutch subsidiaries.

Mechmetel-Towers, Inc., Rochelle Park, N.J., engaged in the design and manufacture of sensitive metal ball bearings and other miniature products offering "Mechmetel," a high speed alloy produced by a multi-stage process. The company is offering \$1,100,000 of 4% convertible cumulative preferred stock at \$5 per share. Mechmetel was acquired by Victor Towers who formed Mechmetel Corp. in 1957 for the purpose of developing and fabricating the product; he was subsequently joined by Philip Hatzopoulos. In 1958 the company contracted to pro-

vide \$150,000 to construct and equip a plant for its new French subsidiary, and \$2,000,000 will be used to repay short-term bank loans.

Schlesinger-Lansted, Houston, Tex., which, in addition to its electrical logging and related services, is engaged in the manufacture of electronic and electro-mechanical equipment, components and systems. (The company recently acquired Deconco, Inc.) Offering of 500,000 outstanding common shares by the parent holder.

choice the investment for \$1,225,000 and, for an additional \$110,000, all of the stock of Mechmetel Corp., which became the company's manufacturing subsidiary. Of the proceeds, \$110,000 will be used to complete payment of the purchase price of the investment, \$100,000 for research and development, the balance of the proceeds will be used to pay a bank loan.

Schlesinger-Lansted, Houston, Tex., which, in addition to its electrical logging and related services, is engaged in the manufacture of electronic and electro-mechanical equipment, components and systems. (The company recently acquired Deconco, Inc.) Offering of 500,000 outstanding common shares by the parent holder.



Outstanding opportunities for: AIRFLOW AND ENVIRONMENTAL TEST ENGINEERS

Qualified well trained and experienced test engineers will be working on new modern laboratories and addressing details of flow-air projects. Immediately we want are the following:

SENIOR ENGINEER - 25-30 years exp. in high speed wind tunnels.

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RESEARCH SPECIALIST - 10-15 years exp. in high speed wind tunnels.

SENIOR RESEARCH ENGINEER - 10-15 years exp. in high speed wind tunnels.

PHYSICIAN AND ENGINEER - 10-15 years exp. in high speed wind tunnels.

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Airlines File Officers' Salaries, Bonuses and Expenses With CAB

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation expenses and stock holdings for the year ending Dec. 31, 1951, as reported to the CAB.

Trans World Airlines reported that it has paid \$1,000,000 in salaries to its 100 top executives. The company also reported that it has paid \$1,000,000 in bonuses to its 100 top executives. The company also reported that it has paid \$1,000,000 in indirect compensation to its 100 top executives. The company also reported that it has paid \$1,000,000 in stock to its 100 top executives.

Eastern Air Lines reported that it has paid \$1,000,000 in salaries to its 100 top executives. The company also reported that it has paid \$1,000,000 in bonuses to its 100 top executives. The company also reported that it has paid \$1,000,000 in indirect compensation to its 100 top executives. The company also reported that it has paid \$1,000,000 in stock to its 100 top executives.

Northwest Airlines reported that it has paid \$1,000,000 in salaries to its 100 top executives. The company also reported that it has paid \$1,000,000 in bonuses to its 100 top executives. The company also reported that it has paid \$1,000,000 in indirect compensation to its 100 top executives. The company also reported that it has paid \$1,000,000 in stock to its 100 top executives.

Delta Air Lines reported that it has paid \$1,000,000 in salaries to its 100 top executives. The company also reported that it has paid \$1,000,000 in bonuses to its 100 top executives. The company also reported that it has paid \$1,000,000 in indirect compensation to its 100 top executives. The company also reported that it has paid \$1,000,000 in stock to its 100 top executives.

Continental Airlines reported that it has paid \$1,000,000 in salaries to its 100 top executives. The company also reported that it has paid \$1,000,000 in bonuses to its 100 top executives. The company also reported that it has paid \$1,000,000 in indirect compensation to its 100 top executives. The company also reported that it has paid \$1,000,000 in stock to its 100 top executives.

Just Published

Communications Satellites

By R. W. B. and J. W. B.

This book contains articles by scientists who are actively engaged in satellite research with the National Aeronautics and Space Administration, General Electric, and the Army, Navy, and Air Force.

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14 shares of common stock at \$1.00 per share. Mr. W. B. B. also received 100 shares of common stock at \$1.00 per share. Mr. W. B. B. also received 100 shares of common stock at \$1.00 per share.

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NORTHROP
AERONAUTICAL CORPORATION

WHO'S WHERE

(Continued from page 57)

Changes

W. M. Silvers, technical assistant to the president of Vetus Associates, Palo Alto, Calif.

Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., has announced the following appointments: **George E. Shaw**, before manager; **Sam M. Eise**, general superintendent; **Donald F. Spangle**, production control manager.

Robert J. Bessett, director of administration and finance, **Northrup Corp.**, Northrop, Mich.; **Anthony G. Galt**, vice president, **General Dynamics Corp.**, Westinghouse, Ind.; has announced the following appointments in the Langston Components Division: **Richard M. Galt**, director of production; **William H. Karch**, director of marketing; **Donald M. Stenhouse**, director of product engineering; **H. Mark Truss**, director of quality and reliability engineering; **Thomas A. McClellan**, division control.

W. Clifford Rhodes, sales manager, **Avco International Corp.**, Avon, N.Y.; **Alto Frank C. Dulak**, customer service manager; **George F. Sheridan**, director of quality assurance.

E. K. Adkins, manager product planning, **Sears Electronics Division**, of **Philco Corp.**, Maitland Park, Calif.

James J. Frank, manager, **Quadrant Electronics Department**, Lockheed Electronics Co., Pleasanton, N.J.; a division of **Lockheed Aircraft Corp.**

Michael W. Rosenblatt, manager international operations, **Sandco Associates, Inc.**, New York, N.Y.

John K. Hilde, general manager, **Kahn and Co.**, Hartford, Conn.; **Marion E. Park**, assistant vice president, **Northrop Corp.**, Northrop, Mich.

C. L. Christensen, director of research, **Avco International Division of Fairchild**, Northrop, Mich.; **Harold W. Hill**, and assistant manager of the corporation.

Arthur E. Nibbel, director of international operations, **Avco International Division of Fairchild**, Northrop, Mich.

Paul Carl, manager general products, **Northrop Corp.**, Northrop, Mich.

Robert M. Wolkstein, director of quality assurance and reliability, **Northrop Corp.**, Northrop, Mich.

Jack J. Macosko, director, Research and Engineering Department, **Avco International Division of Fairchild**, Northrop, Mich.

Virgil W. Janssen, manufacturing manager, **East Division**, **Northrop Corp.**, Northrop, Mich.

Frank Villalobos, Jr., director of marketing, **Worcester-Pilbeam Corp.**, Worcester, Mass.

Edith L. L. Pridgen, sales service manager and director of training, **General Dynamics Corp.**, Northrop, Mich.

James E. J. Morris, engineering manager, **East Division**, **Northrop Corp.**, Northrop, Mich.

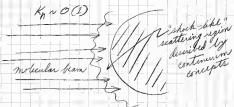
Robert E. Galt, director of quality assurance, **Northrop Corp.**, Northrop, Mich.

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Robert E. Galt, director of quality assurance, **Northrop Corp.**, Northrop, Mich.

Of interest to engineers and scientists



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...one of more than 500 R&D programs under way at Douglas

In this study, Douglas scientists and engineers are investigating phenomena in the transition region between extremely rarefied and continuum regimes of hypersonic flow.

Included are programs for studying the basis for a two-fluid rarefied flow theory; aerodynamic characteristics of selected configurations in hypersonic rarefied flow; initial establishment of flow fields about objects entering the atmosphere; and the dynamics of vapor generated by the sublimation of the surface of simple shapes in a low density atmosphere.

A "two-fluid" flow model has been successful in aiding the description of shock wave structure and drag coefficients in low density flows.

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Expanded Douglas participation in major U.S. missile and space programs has created a stim-

ulating environment in which you can further your career. Sponsor of these projects are Air Force, Army, Navy, NASA, commercial aerospace, and Douglas. Work areas range from pure research, through applied research, development, manufacture and test of complete systems. Every major engineering and scientific discipline relating to aerospace is involved.

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ation: *Work addresses the questions we students on the issues raised in the journal's editorial columns. Addressers to the Editor, American Work*, P.O. 4262 St., New York 26, N. Y. We hope letters under 500 words and a genuine contribution. We will print anonymous letters, but names will be withheld on request.

Your editorial on "The New Annual Copyright" (AW July 3, p. 13) really hits home—in a tough way. How about following it by a critical analysis of some of the classic "highlights" of World War 2 for which the awards were clearly responsible, to wit:

4 "You can't build a self-serving god on a tank." (Wolfehouse dad)

In each case it was the integrity and re-
sponsibility of the courts concerned, the

Consulting Engineer
Fayetteville, N.Y.

Add to the mix a government approval required to change jobs, plus a government-level union, and we have complex chaos.

I recommend that your readers read the book "After Shogun" by Amy Rand, so they can see the consequences of the war.

E. C. Nasser
 Cincinnati, Ohio

Location: Work addresses the sponsors of the protests on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Newsweek*, Work, 430 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Having been a "reliability type" for almost a decade now, I was glad to see you editorial on "Reliability in Space" in the 11 June issue (p. 21). I think your readers would be interested in knowing that CCR's contract with NASA is to perform and deliver the reliability and quality control aspects of Apollo 8, but not of several other contracts. These contracts resulted from the third basic element of NASA's present reliability policy.

Since it may be of interest to you Jordan, the three basic elements of the policy are:

• **Fact:** It is a fundamental NASA policy to utilize every practical means of achieving high system reliability at the earliest possible stage of system obligation.

- **Second:** To accomplish the overall policy objective, appropriate reliability program requirements shall be placed on contractors for major NASA systems.
- **Third:** Contractor performance in achieving system reliability will be measured by the cognate NASA Center with the aid of specified reliability construction, as appropriate.

In addition to the Apollo effort mentioned in your editorial, specialized reliability contractors that have been selected by NASA to date and the corresponding major NASA systems are: Space Aeronautics and Astronautics (SAO); Planning Research Corp. for the Orbital Astronomical Observatories (OAO); Ames Research Corp. for Saturn and Operations Research, Inc., for the Nuclear Astronomical Observatory. At the moment, similar contractual assistance from specialized reliability contractors is present and future NASA systems is under consideration.

Very briefly stated, each independent or hybrid contractor assesses NARA by providing unique independent resources if solutions and system reliability by solving the enhancement of existing system reliability goals and by generally acting as a technical advisor to NARA in system reliability matters. For OIGD, the PMO requires more approach is being utilized to assess specific reliability. Some personnel take the classical "black or white" reliability approach, the approach establishes a measure of expected value of system performance that takes into account degradation as well as catastrophic failure, whereas an increase

Denise R. Craven,
Deputy Manager
Reliability, Maintenance, and Test Dept.
Hawking Research Corp.
Los Angeles, Calif.

Over 80% of the so-fight mailboxes of our newspaper efforts are attributed to environmental efforts. Yet the environmental

response in most computers is considered an overhead expense required only because of the necessity to test in arbitrary specifications. The act of environmental testing requires years of experience. The reliability of the experiment is proven in the test chamber.

In few companies you will find the environmental test engineers involved on the conceived design but too often you will find him on the target for breaking up a chief engineer's creation.

—DONALD L. ECK

President
Institute of Technological Sciences

Our courts can punish those who joke about explosives on airplanes, but the prospect of financial gain still exists for the sale of large airline trip insurance policies.

It is not idle to say that the profit motive has been a factor contributing to the death of hundreds of innocent passengers and crew members. And it should be apparent to everyone that companies which treat air passengers for high rates—and only for the duration of the flight—need only supply the means for murder in the air to see extremely the ones to profit by the sale of

How can we justify providing anyone who considers a \$10,000 policy sufficient to make average circumstances to get a payout of \$121,400 as his loss to society in the event he is killed in an airplane accident?

I propose that if he made illegal for anyone to carry larger trip insurance in excess of a value equal to the policies mentioned in effect for the preceding year, and that if someone is injured, the remainder of the

amount of selling (or purchases) he purchases the principal sum to be paid in the case of a total accident will be equal only to that of his normal policies. This would place some standard of value on selling (or purchases)

Blivett, the day is basically the last when it comes to the purchase of admission tickets.

The recent wave of aerial piracy brought swift Federal legislation that put an end to hijacking in the sky. Perhaps through the government we can demonstrate a similar concern for the safety of the flying public by placing a reasonable ceiling on airline trip insurance.

East Windsor
Yellow Birch 1.48

100

It can pinpoint a long-range missile on target. Guide a satellite or space ship to any point in the universe. Regulate the predetermined course of a surface vessel or submarine to any spot on the green globe — by any route, however circuitous.

In manned vehicles, it will give exact position — even without an atmosphere — independent of gravity, sea, wind, and weather conditions — without fixes on horizon or stars — after days and weeks of travel.

This is **Hipermax**, a self-compensating, pure inertial guidance system developed by Bell's Avionics Division (awarded for the U.S. Air Force). **Hipermax** is a vers-

tic that a whole family of related systems has been engineered for application in any environment — sea, sky, or space.

The system introduces new Bell BRIG gyro, Br accelerometers and digital velocity meters and already operational in missile and space guidance systems.

Hipermas — and many other systems such as the Av. Force GSN-5 and the Navy's SPN-10 All-Weather Automatic Landing System — typify Bell's capabilities in the broad field of electronics. The diversity of activities offers an interesting personal future to qualified engineers and scientists.



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PHANTOM II . . . THREE SERVICE FIGHTER

Never before has one aircraft so indelibly marked the pages of military aviation history. It is appropriate that the Phantom II will now serve three air arms of our nation.

This multiple mission fighter, designated F4H-1, is already in service as an air defense interceptor for the United States Navy. With the same designation, the Phantom II will soon be delivered to the United States Marines for close support and air superiority missions. Designated the F-110A and the RF-110 by the United States Air Force, this versatile aircraft is now being built to augment the tactical strike and reconnaissance capability of that service.

RECORD FLIGHTS OF THE PHANTOM II:

| | |
|---|-------------------|
| 16 kilometer straightaway | 1606 mph |
| 3 kilometer low altitude | 902 mph |
| 100 kilometer closed course | 1390 mph |
| 500 kilometer closed course | 1216 mph |
| Sustained altitude (level flight) | 66,443 feet |
| Los Angeles to New York | 170 minutes |
| Altitude | Over 100,000 feet |
| Time to Climb (in meters): | |
| 3,000 | 34.52 seconds |
| 6,000 | 48.78 seconds |
| 9,000 | 61.62 seconds |
| 12,000 | 77.15 seconds |
| 15,000 | 114.54 seconds |
| 20,000 | 178.50 seconds |
| 25,000 | 230.44 seconds |
| 30,000 | 371.43 seconds |

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